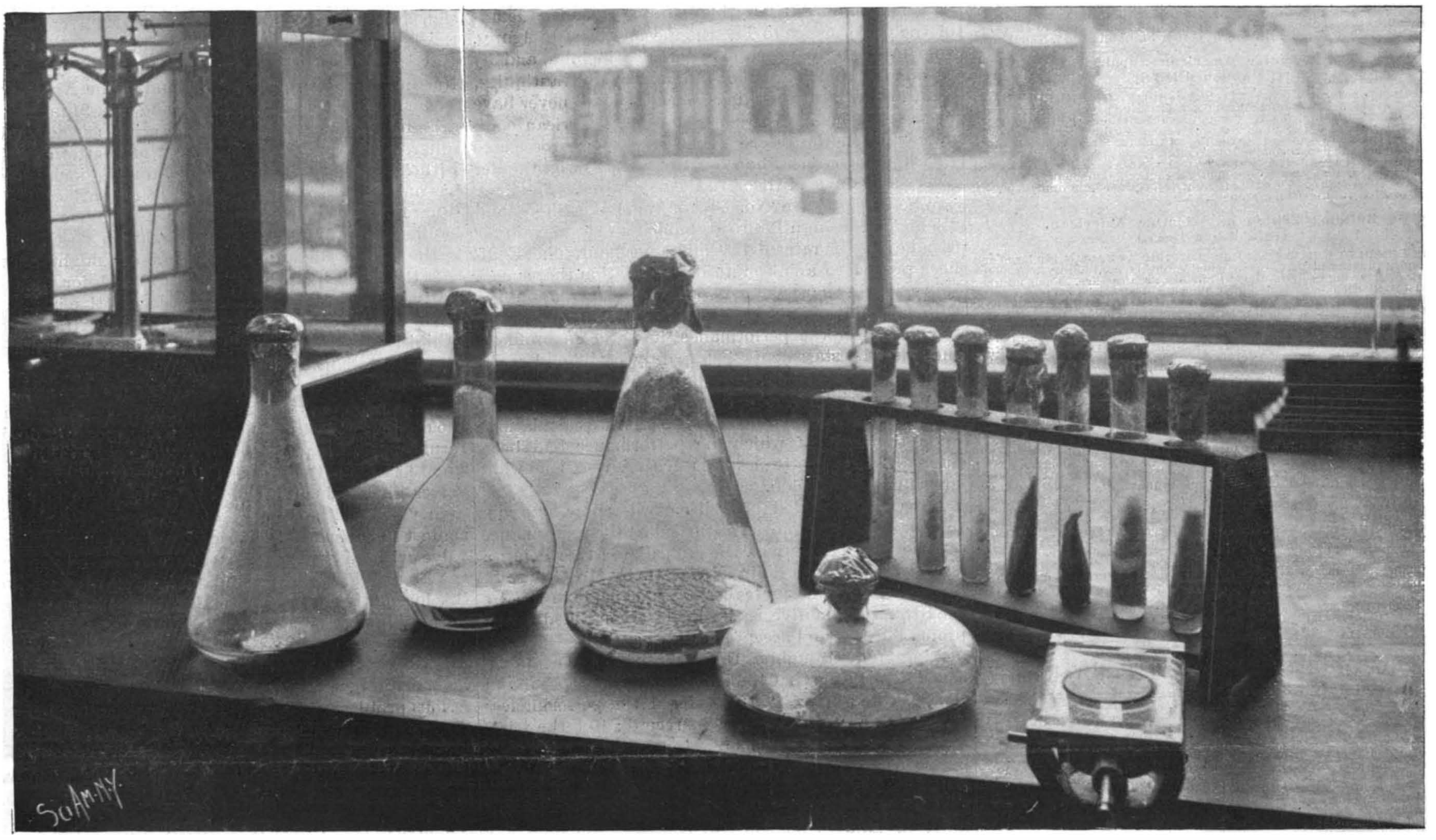
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y. as Second Class matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXVI.—No. 10. ESTABLISHED 1845. | NEW YORK, MARCH 6, 1897. | [$3.00 A YEAR. WEEKLY.



CULTURES OF BACILLI TUBERCULOSIS.

LABORATORY AT SARANAC LAKE, N. Y., FOR THE STUDY OF TUBERCULOSIS—INTERIOR OF MAIN ROOM.—[See page 152.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

NEW YORK, SATURDAY, MARCH 6, 1897.

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Price 10 cents. For sale by all newsdealers.

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AMERICAN RAILWAY SPEEDS.

The Engineer, of London, is greatly disturbed from time to time because American railroad men—managers, master mechanics and engineers—persist in crediting their own locomotives with feats of speed and hauling power which are entirely beyond the capabilities of any English locomotive. This periodic irritation is discernible in every announcement of an exceptional American locomotive performance that may appear in the columns of our contemporary. Ordinarily the vexation appears in the form of an obvious query mark, deftly woven into the phraseology of what purports to be a simple announcement of the fact that a fast run has been made. But if the run should happen to have been particularly brilliant, the editor's wrath is manifested by his handing over the details of the performance to The Engineer's expert in figures, who proceeds to prove on general principles, and by the aid of sundry formulæ of unimpeachable antiquity, that, in the nature of things, the feat could never have been performed. No sooner does an American engineer "smash the record" than the expert proceeds to smash the engineer, burying the luckless wight under a very avalanche of theoretical calculations.

When locomotive No. 564, of the Lake Shore and Michigan Southern Railroad, hauled a 150 ton train for 86 miles at the rate of 72·9 miles per hour, The Engineer proved to an absolute demonstration that such a thing could never have occurred. Thereupon the editor was favored by the officials of the road with all the details of the performance, including a profile of the line, the statements being duly certified by the proper parties. This brought forth an acknowledgment that, in the presence of such overwhelming testimony, some revision of the elaborate calculations upon the basis of which the performance had been discredited by the expert was necessary—a somewhat superfluous admission.

After a brief period of well earned repose, our contemporary has again been disturbed by the performance of American locomotives, the immediate cause being a letter written to the Railroad Gazette by Mr. George S. Strong, in which he quotes certain runs made in 1887 by the Strong locomotive, runs which were certified by the proper officials and accepted as authentic by the engineering press throughout the country. It was acknowledged at the time that the loads hauled, the speed, and the indicated horse power rendered the performances among the most remarkable on record; but the trials were so carefully carried out, and the facts were reported by such impartial and unimpeachable witnesses, that they have never been seriously questioned.

The Engineer, however, again doubts the credibility of railroad men in this country, and does not hesitate to say so. It proceeds to demolish their testimony in its customary and familiar style. The controversy is too lengthy for reproduction in these columns, but Mr. Strong's letter to the Railroad Gazette, The Engineer's criticism, and a reply by Mr. Strong addressed to the editor of the SCIENTIFIC AMERICAN will be found in the current issue of the SUPPLEMENT.

We are given to understand that, as on the occasion of the Lake Shore run above referred to, The Engineer is to be supplied with the certified statements of the officials of the roads on which the runs were made, on the receipt of which, no doubt, our contemporary will proceed to revise its already revised calculations.

In general it may be said that it is altogether absurd to make the data of English locomotive performance the basis of an argument as to the possible or impossible performance of an American locomotive, so radically different are the leading features of the two designs. The American machine can haul the larger loads because it is specially designed to do so, and the same reason must be given for the relatively large horse power which it is able to indicate, and does indicate, on such runs as these in question. Indicated horse power is the product of piston pressure by piston speed, and the locomotive that is able to maintain a high mean piston pressure in conjunction with high piston velocity will show a proportionally large horse power. The American locomotive is provided with large port areas and drivers of moderate diameter; and in running a given distance, when working up to its full power, it will use a far greater volume of steam in its cylinders than an English locomotive with its seven or eight foot drivers and slower piston speed. The ports of an English locomotive's cylinders are short and cramped, ill adapted to give that free admission and escape to the steam which is essential to effective work at very high speeds. The slow piston speed and the low mean cylinder pressure will account for the small indicated horse power of English locomotives, which ordinarily ranges from 700 to 800; whereas the locomotives that haul the heavy expresses in this country will indicate from 1,100 to 1,300 horse power when working up to their full power. Just here lies the explanation of the relatively great size of locomotive boilers in America. Engines that use such large volumes of steam require large boiler capacity; and hence the latest boilers in this country have from 1,800 to 2,200 square feet of heating surface, as against from 1,000 to 1,300 square feet in England.

Other things being equal, the locomotive that can pass the greatest weight of dry steam through its cylinders, in traversing a given distance on the rails, will exert the greatest power. English engineers, who are continually expressing their surprise at the enormous size of American locomotive boilers, should bear in mind that it is its large boiler capacity which primarily enables the American locomotive to haul heavy loads at speeds which are altogether beyond the power of the English machine.

The English locomotive is handicapped at the very start by its small boiler with only 1,000 to 1,200 square feet of heating surface, and the valve gear and piston speed are proportioned to match it, the ports being small and the piston speed slow. The extremes of design are shown in a comparison of such engines as the new express locomotives of the New York, New Haven and Hartford Railroad in this country and the Northeastern Railroad in England. The New Haven locomotive, with 6 foot drivers and 20 × 24 inch cylinders, has 2,114 square feet of heating surface and 30 square feet of grate area. The Northeastern engine, with 20 × 26 inch cylinders and 7 foot 7¼ inch drivers, has only 1,216 square feet of heating surface and 20 square feet of grate area. For a supreme effort in hauling a maximum load at a maximum speed, which is the correct design? The Engineer might answer that the English engine is not designed for such excessive work. But the American locomotive is, and by virtue of its design it is capable of those extraordinary exhibitions of power which our contemporary finds it difficult to credit.

The locomotive which made the runs that are now called in question represents an extreme application of the distinctive features of American design. The double furnace gives 60 square feet of grate area, as against 20 square feet in the English locomotive; the gridiron valves give 34 inches lead line or length of port on each valve, with an area of 25½ square inches, as against 10 inches lead line or length of port on each valve with an area of 12½ square inches on the average English locomotive; and with a 75 per cent cut-off this locomotive has given as high as 150 pounds mean pressure in the cylinders.

In conclusion it may be said that if the designers of English locomotives would cease to strive after an ideal economy in fuel, and devote their attention to the more serious problem of hauling heavy loads at high speed, they could solve the problem at once by adopting the practical and common sense methods of American builders; moreover, if The Engineer would spend as much time and energy in teaching its readers *how* and *why* the American locomotive *does* certain things as it now spends in trying to prove that it never has and never will do them, it would be more in line with modern developments and less open to the charge of persistent and unreasonable prejudice.

"DEFECTIVE PATENT LAWS."

The love of criticism is a quality inherent in human nature. Perfection is never attained by man, and his work is always open to unfavorable comment. This statement applies broadly to almost every case, and holds even when the critic has accurate knowledge of the subject he treats of. But the wings of his imagination work with infinitely greater vigor when they move in an atmosphere of ignorance. He has but to assume the facts in the case and then to criticise them, and his work is done.

Recently the patent law of the United States has been thus criticised by one of our Chicago contemporaries. Among its editorial articles appears one bearing the title "Defective Patent Laws," which criticises unfavorably what the writer of the article in question conceives the patent laws of this country to be, and undertakes in this vein of ignorance to compare them with those of foreign lands. The utter ignorance of existing facts, and the misconception of the scope of the patent system, is impressive. It is also impossible to ascertain whether the writer thinks that the inventor is too hardly dealt with or whether he considers the public the sufferer. Our only inducement to notice an article containing such a mass of misstatements is the fact that the journal has a somewhat wide circulation, and will go to inspire discontent with the patent statutes. On them a vast body of decisions and rules of practice have been based, and, consequently, our patent law is so well formulated that its practice has become practically codified. A lawyer who takes out a patent for a client knows what he has to expect from the Patent Office examiners, and works in the full enlightenment of such knowledge. He has in his mind the general scope of decisions in the circuit and supreme courts, and formulates his claims in accordance therewith. Radical changes in the patent law would work irreparable harm to inventors by putting them at sea with regard to their rights. Stability is a necessity in the case of patent franchises.

A mistaken apprehension as to the scope and function of a caveat marks the opening of the article. The writer states that a caveat is objectionable, as by the payment of ten dollars per annum it may be kept alive and practically extend the life of a patent for an inde-

finite period, giving the inventor protection for any number of years. In this erroneous statement we find the expression of a common misapprehension. A caveat is simply a memorandum filed in the Patent Office, entitling the inventor to notice of the filing of an application by another. A caveat protects the inventor but not the invention. The protection it affords is not the same as that of a patent, and it has no standing in court which could render it a protection against infringements. While the caveat remains in force, the inventor may apply for a patent, and when the patent has been issued, and then only, his rights can be enforced. He may extend a caveat for a term of years by annual payment, but the extension is not one of right to a patent, but only of right to a notice of another person applying for a patent. A caveat extended for a long period would, on the contrary, imperil the standing of an inventor in court as showing want of diligence on his part in filing his application or perfecting his patents. The editorial then objects to the length of term of United States patents and cites the admirable practice of the Russian Patent Office in this respect, which issues a patent, it states, for a term not exceeding ten years. It seems rather strange that a progressive people like ourselves should be called upon to admire the antiquated patent system of Russia, with its exorbitant fees and impracticable methods; but the writer was again speaking in crass ignorance, for on July 1, 1896, the Russian government instituted a new patent system, making the life of a patent fifteen years.

The power of Congress to extend the term of United States patents is then taken up, and the writer waxes eloquent over the great wrong in extending these privileges to the bloated inventor. We would like to ask whether our esteemed contemporary is not aware that it is years since Congress has granted a petition to extend the terms of a patent, and then only with good cause.

So far the writer of the article which we criticise has taken a position opposed to the inventor, seeming to think that too much consideration is awarded him by the law. Now a change of front occurs, and an old complaint is brought forward by the writer, in the assertion that a patentee is at the mercy of infringers unless he has capital. If his patent is meritorious he never need be without capital. The federal government does what it can to protect the inventor; it opens to the patentee the highest tribunal of the United States for the determination of his rights.

The Patent Office examination, which is made before the patent is issued, is an admirable system and enables the inventor to learn definitely the state of the art before the term of his patent has begun to run. Our enlightened contemporary thus indorses the system of our friends beyond the sea: "In Norway and Great Britain questions of alleged infringements must be settled before a patent is issued, and the patentee may then reap the full benefit of his invention without fear of interference."

This statement is absolutely without foundation. In Great Britain there is no examination by the government, and the patent is issued, irrespective of novelty, to the first applicant. The issuing of the patent there is no guarantee or evidence of novelty, and the true value of the patentee's rights are not tested until after the patent is issued. In Norway there is a superficial examination only.

Another point made in the article we discuss is that the payment of the full fee before the patent is issued is onerous. The practice in other countries where annual payments are required is cited as an example of more liberal treatment of the inventor. Experience proves this not to be the case. In fact, the cost of a United States patent is in the aggregate less than that for any other country. The United States exacts two nominal fees only—one of fifteen and another of twenty dollars; and for this total of thirty-five dollars the seventeen year franchise is granted. No greater liberality could be rationally expected. The annual fees exacted under the laws of other countries are often onerous and aggregate quite a large sum if extended over many years, amounting in some countries to $1,500 in taxes alone.

The criticisms so often expended on the United States patent laws are generally the outcome of ignorance or misconception. The theory is especially an object of misapprehension. Practically the encouragement of inventors brings about the enrichment of the country and the advance of its most important interests. The way to render the protection at once ample for the inventor and fair to the rest of the country is to publish the invention and to lay it open to the world. This opening to the world is expressed, etymologically speaking, in the word "patent." This surrender of his closely guarded secret is the inventor's price for statutory protection.

We cannot better close this notice than by quoting the final words of our contemporary: "Where the genius of invention in all branches of industry is as active as it is in this country, the protection of the laws to the inventor should be as liberal as in any other country on the globe."

By all means, so be it. We believe our patent system already meets this high standard. That there are defects no one can deny, but we believe our system to be the most just, equitable and efficient system of that in force in any country.

THE HEAVENS FOR MARCH.

BY WILLIAM R. BROOKS, M.A., F.R.A.S.

THE SUN.

The sun's right ascension on March 1 is 22 h. 51 m. 26 s.; and its declination south 7 deg. 17 m. 16 s. On the last day of the month its right ascension is 0 h. 41 m. 21 s.; and its declination north 4 deg. 27 m. 8 s.

On March 20 at 3 A. M. the sun crosses the celestial equator on its northward journey, enters the first point of Aries, and spring commences.

Telescopic observation of the sun will prove of interest to the student. The great sun spot of January came into view again by the sun's rotation early in February, according with the prediction.

It was in good position on the 5th, when it was photographed, and drawings made at this observatory. It had changed in form considerably, and was smaller than in January, but was plainly visible to the naked eye through a smoked glass. In the telescope it presented a fine appearance. This spot will probably reappear by rotation, and be in good position the first of March.

MERCURY.

Mercury is morning star, but is not very well placed for observation except at the beginning of the month. On the first day of March at 8 h. A. M. Mercury is in conjunction with the moon, when the planet will be 1 deg. 57 m. south of the moon. The right ascension of Mercury on March 1 is 21 h. 29 m. 48 s.; and its declination south 16 deg. 32 m. 53 s. On the last day of the month its right ascension is 0 h. 23 m. 17 s.; and its declination north 0 deg. 56 m. 4 s.

VENUS.

Venus is evening star, and so glorious an object that no one can view it without an exclamation of delight. A peerless celestial diamond. It is now seen at a high altitude in the western heavens as soon as it is dusk.

Venus is at its greatest brilliancy on March 21, and for some time before and after that date is visible to the naked eye in the day time. After dark, on a clear evening when the moon is absent, the light of Venus is so intense at the period of greatest brilliancy that objects in its path will cast very distinct shadows. Upon the snow this is very marked indeed.

Venus is in perihelion on March 4, and on the 26th reaches its greatest heliocentric latitude north.

On the 7th of the month, at 8:30 A. M., Venus is in conjunction with the moon, when the planet will be 1 deg. 25 m. south of the moon.

On the first of the month Venus crosses the meridian at 2 h. 58 m. in the afternoon, and sets at 9 h. 45 m. P. M. On the last of the month Venus crosses the meridian at 2 h. 9 m. in the afternoon and sets at 9 h. 30 m. P. M.

The right ascension of Venus on the 15th day of the month is 2 h. 17 m. 42 s., and its declination north 18 deg. 45 m. 14 s.

MARS.

Mars is evening star, and is in quadrature with the sun, or ninety degrees therefrom, on March 18. Its distance from the earth is rapidly increasing, but very good observations of the planet may yet be made.

Mars is in conjunction with the moon on March 11 at 6 h. 43 m. P. M., when Mars will be 1 deg. 34 m. south of the moon.

On the first of the month Mars crosses the meridian at 6 h. 42 m. P. M. and sets at 2 h. 20 m. after midnight.

On the last of the month it crosses the meridian at 5 h. 43 m. P. M. and sets at 1 h. 20 m. past midnight.

The right ascension of Mars on the 15th of the month is 5 h. 47 m. 54 s. and its declination north 25 deg. 43 m. 42 s.

JUPITER.

Jupiter is evening star, having passed opposition with the sun on the 23d of February, when it changed from morning to evening star. It is a beautiful and conspicuous object in the eastern evening sky. Jupiter is in the constellation Leo, a few degrees east of Regulus. This is a most favorable time for telescopic work upon Jupiter, its wonderful belts and beautiful moons forming charming celestial pictures. The following are some of the interesting phenomena of Jupiter's satellites for March. On March 4 at 9 h. 50 m. P. M. the I satellite disappears in occultation. At 21 m. past midnight satellite I reappears from an eclipse. At 3 h. 53 m. the same morning the II satellite enters upon the disk of the planet in transit; and at 4 h. 22 m. the shadow of satellite II enters in transit.

On March 5 at 7 h. 9 m. P. M. the I satellite enters upon the disk in transit. At 7 h. 24 m. P. M. the shadow of satellite I enters upon the disk in transit. At 9 h. 19 m. 15 s. the III satellite reappears from an eclipse. At 9 h. 28 m. the I satellite will egress from transit; and at 9 h. 43 m. the shadow of satellite I will pass off the disk. Thus, in about two and one-half hours of a single evening, we have five distinct and interesting events in the phenomena of this giant planet. On March 13 at 8 h. 43 m. 44 s. P. M. the I satellite will reappear from an eclipse. At 1 h. 9 m. past midnight the II satellite will disappear in occultation. At 4 h. 52 m. 46 s. the same morning, the II satellite will reappear from an eclipse. On March 21, at 7 h. 24 m. P. M., satellite I will egress from transit; and at 8 h. 1 m. the shadow of satellite I will pass off the disk of the planet. On March 28, at 6 h. 51 m. P. M., the I satellite will enter upon the disk in transit. At 7 h. 36 m. P. M. the shadow of satellite I will ingress. At 9 h. 10 m. the same evening the I satellite will pass off the disk; and at 9 h. 55 m. the shadow of satellite I will follow.

On March 16, at 11 h. 22 m. P. M., Jupiter will be in conjunction with the moon, when the planet will be 3 deg. 15 m. north of the moon.

On the first of the month Jupiter rises about 5 o'clock in the afternoon, and comes to the meridian at 11 h. 46 m. P. M. On the last of the month Jupiter comes to the meridian at 9 h. 36 m. P. M. and sets at 4 h. 20 m. A. M.

The right ascension of Jupiter on the fifteenth day of the month is 10 h. 20 m. 36 s. and its declination north is 11 deg. 45 m. 49 s.

SATURN.

Saturn is in the morning sky and slowly coming into better position for telescopic observation. It is on the borders of Scorpio, about ten degrees northwest of the bright star Antares. On the ninth of the month Saturn is stationary.

On the first of the month Saturn rises at 24 m. past midnight, and crosses the meridian at 5 h. 18 m. A. M. On the last of the month it rises at 10 h. 25 m. P. M., and crosses the meridian at 3 h. 15 m. A. M. The right ascension of Saturn on the fifteenth of the month is 15 h. 56 m. 14 s.; declination south 18 deg. 9 m. 57 s.

URANUS AND NEPTUNE.

Uranus is in the morning sky, in the constellation Scorpio, and very close to Saturn. All through the month of March it is about two degrees southwest of Saturn.

Neptune is in the evening sky in the constellation Gemini. At the beginning of the month it is between the feet of Castor, one of the Twins. On March 7, Neptune is in quadrature with the sun.

Smith Observatory, Geneva, N. Y., February 19, 1897.

THE REMARKABLE LONG DISTANCE RUN.

The run of 1,026 miles at the rate of 58·74 miles an hour, mentioned in our last issue, by a special train over what is known as the Burlington route from Chicago to Denver, was in some respects the most remarkable of the many similar performances of recent years. There have been faster long distance runs for a shorter total distance, and other runs of this class have been made with heavier loads; but taken as a feat of fast passenger travel for the given distance it stands today as an altogether unrivaled performance.

There is a special merit attaching to this performance from the fact that it was called for at the shortest notice, and the railroad used the engines which were readiest to hand. Moreover, the object of the effort was not to gain the notoriety which attaches to a run of this kind, but it was the thoroughly legitimate one of placing a father as quickly as possible at the bedside of his dying son. The journey was made in a special car which was hauled by nine different engines.

The greater part of the work was accomplished with standard American 8 wheeled locomotives, with 17 by 24 inch or 18 by 24 inch cylinders, and weighing about 80,000 pounds. One stretch of 57 miles was covered with a mogul locomotive with 19 by 24 inch cylinders, and 185 pounds of steam, whose weight was 110,000 pounds; and for 143 miles of the trip a 10 wheeled locomotive, weighing 120,000 pounds, with 19 by 24 inch cylinders and 185 pounds of steam, was employed. It is noticeable that none of the driving wheel centers were above 62 inches—a remarkably small dimension, considering the high speed that was maintained.

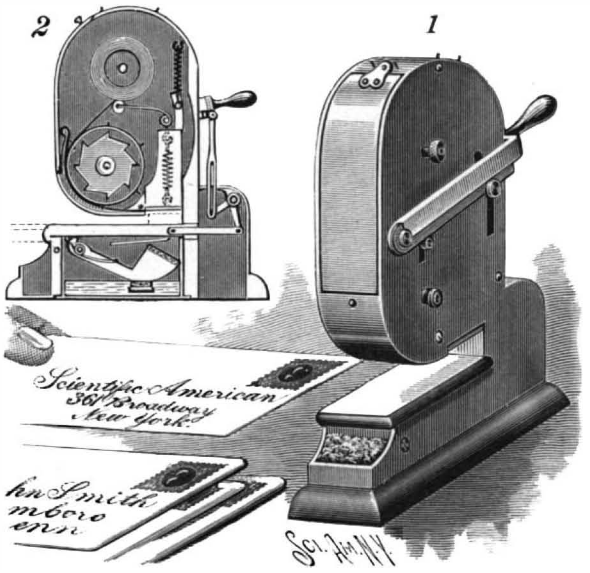
The Denver station is 4,583 feet above the level of the Chicago station, and the total time occupied in covering the 1,026 miles between the two points was 18 hours 53 minutes. This gives an average speed of 54·27 miles per hour inclusive of stops. The average speed, exclusive of stops, was 57·53 miles per hour.

SAGACITY OF HORSES.

In the year 1872, during a skirmish with the Sioux Indians, the Third United States Cavalry formed an encampment in a valley on the southern border of Dakota. At nightfall the horses were tethered by a long line to the ground. Toward daybreak a violent storm of rain and hail burst over the valley, when the terrified animals broke loose from their fastenings and tore away up the steep sides of the valley into the territory of the enemy. Without horses, at the mercy of the enemy, we would have been lost; yet it was impossible, in the darkness, to go after them into an unknown country, probably full of Indians. The commanding officer, as a last resource, ordered the stable call to be sounded. In a few minutes every horse had returned to the encampment, and we were saved.—Thierfreund.

A MACHINE FOR STAMPING ENVELOPES, ETC.

The illustration represents a machine from which stamps may be fed out one by one, moistened, and applied to a letter or package, Fig. 1 showing the machine in perspective, and Fig. 2 being a vertical section. The improvement has been patented by Winfield L. Dinsmoor, of Portland, Oregon. The top portion of the base of the machine is cushioned and adapted to slide a limited distance, as indicated by the dotted lines, this movement being effected by pressing inward a handle, which, while making an opening to the chamber below, also actuates a sponge-holding or moistening pad lever to move the sponge or pad upward through the opening. The construction is such that the sponge or pad does not come in contact with the body of the water below, and is thus prevented from carrying an access of moisture. In the upper part of the casing is a drum, on which is wound a tape made up of stamps, engaged by a friction roller as it is unwound and passed around a lower wheel, on which are teeth adapted to enter the perforations between the stamps, the stamps being held in position on the wheel by a spring guard, and the lowermost stamp being passed through a spring throat plate in the bottom of the casing, and beneath a vertically moving plunger. The stamp drum may be turned by a thumb wheel from the exterior of the casing, on one edge of which is a door through which the stamps are introduced. The plunger is normally held in raised position by a spring, but is adapted to be forced downward by a yoke lever, a cross bar of which extends through curved slots in the sides of the casing, an arm from this lever actuating the stamp-carrying wheel. When the handle at the base is pushed inward, the lever carrying the moistening pad moves the latter up through the opening to moisten the stamp, a spring returning the table to its normal position as the pad drops down, and, on pushing down the yoke lever handle, the plunger presses the moistened stamp upon the envelope or package placed in position beneath it.



DINSMOOR'S STAMP AFFIXING MACHINE.

A NEW FIELD GLASS.

The telescopes employed for effecting the magnification of terrestrial objects or, what amounts to the same thing, for bringing them apparently nearer to us, are of two kinds—the spy glass and the Galileo telescope. Each of these has its advantages and its inconveniences. The spy glass, in consequence of its optical system, which employs long foci, and in which the image given upside down near the objective must be righted by means of supplementary lenses, is always quite cumbersome, even for relatively feeble magnifications. Consequently, it would be impossible to mount it in the form of a field glass; and this is to be regretted, because we thus lose the benefit of binocular vision, which permits us to perceive relief. The Galileo telescope is much shorter, and the image is righted by the ocular, which is divergent. Consequently, it is more luminous. So for field glasses it is always this that is employed. But it embraces too limited a field, and, moreover, for high magnifications it rapidly loses the advantage of being shorter, since, although for a magnification of two diameters it is two-thirds shorter than the spy glass, for a magnification of ten times the difference it is no longer, but a fifth shorter.

In order to have a manageable telescope capable of being mounted as a field glass having quite a wide field, a strong magnification, and luminosity, it would be necessary to find some means of modifying the spy glass in shortening its focus and suppressing the system of lenses that rights the image. It was Porro, a French physicist, who first pointed out the course to pursue in order to obtain such a result. He employed two total reflection prisms, which forced the luminous ray to return twice upon itself, and, at the same time, righted the image. But the tentatives made by him and a few others (Hoffmann especially) to attain a practical result were unsuccessful.

It was but a short time ago that Zeiss, the well known optician of Jena, succeeded in applying this method with entire success to a new system of field glass, which we have seen experimented with at the establishment of Mr. Krauss, the grantee of the Zeiss patents for France.

As may be seen in Fig. 1, which gives a section of the optical system, the luminous ray entering through the objective falls upon a total reflection prism that sends it to a second and similar prism, where it is broken anew in order to go to the ocular. It might be supposed that the use of two prisms would suppress much light and cause the loss of the benefit resulting from the doing away with the righting of the image by a system of lenses. But such is not the case, since the prism allows of the passage of much more light than does a lens in which the central part is almost solely utilized in consequence of the use of the diaphragm. Besides, these prisms are of glass of such purity that when placed upon a sheet of white paper, we distinguish no difference in tint between the portion of the paper that they cover and that which is not covered. There is another great advantage that results from the mode of construction of these field glasses, and that is the increase of the sensation of relief due to the spacing of the objectives. It will be remarked, in fact (Fig. 2), that although the oculars are necessarily at a distance of six or seven centimeters (which is that of the mean distance between the eyes), the objectives, as a consequence of the use of the prism, are separated from each other by eleven centimeters. Now we know that the stereoscopic effect is so much the more marked in proportion as the points of view whence the rays reach the observer's eye are farther apart. This principle, moreover, was studied by Helmholtz, who, under the name of the telestereoscope, proposed an apparatus in which the rays were reflected from mirrors. It was in following up this idea that Zeiss constructed a second model of field glass in which it is possible to increase the distance between the objectives indefinitely, so to speak. The diagram in Fig. 1 will show how this result is reached. Opposite the objective there is a total reflection prism, A, which sends the ray to a second prism, B, capable of being placed as far from the first as may be desired, the spacing being determined by the focal length of the field glass.

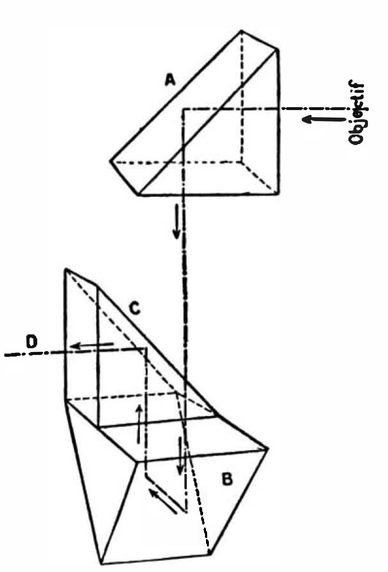


Fig. 1.—PASSAGE OF THE RAYS IN THE STEREOSCOPIC FIELD GLASS.

After being twice reflected in the prism, B, the ray meets a second prism, C, which sends it to the ocular. In the instrument constructed upon this principle (Fig. 3), and which is called a stereoscopic field glass, a joint permits of placing the two tubes of the glass in the prolongation of one another (No. 1) or parallel (No. 2), for the sake of ease of carriage. These two positions may be utilized in two special cases: In the first, for example, one can stand behind a tree (No. 3) and in the second behind a wall (No. 4) for making his observations more at ease.

When a landscape is examined with this new type of field glass, the observer is surprised at the relief that the image assumes. The objects place themselves in their respective planes, and it is possible to ascertain their exact position. From a military standpoint, such instruments are destined to render genuine services by permitting of better estimating distances for the regulation of firing, of more distinctly seeing the work done by an enemy, and of estimating the depth of a body of troops located at a distance. They will prove the indispensable complement of every officer's equipment.—La Nature.

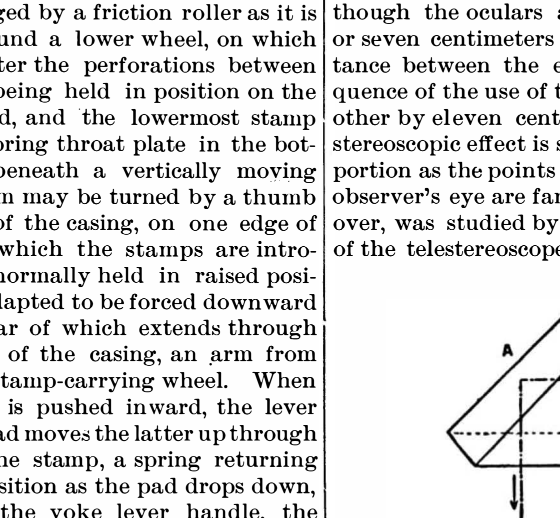


Fig. 2.

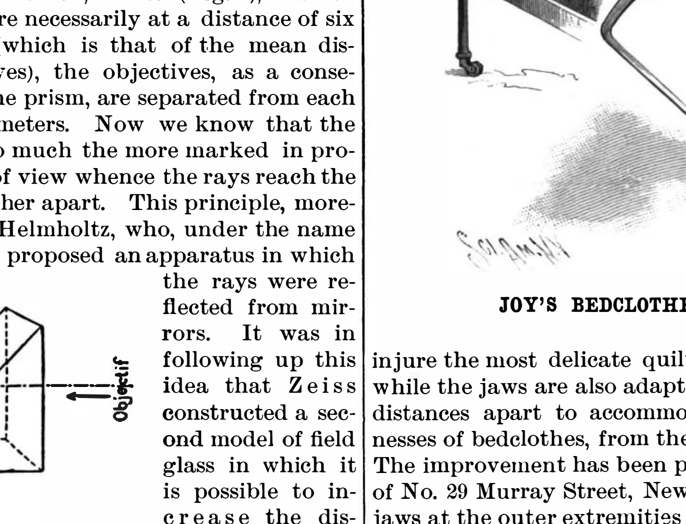
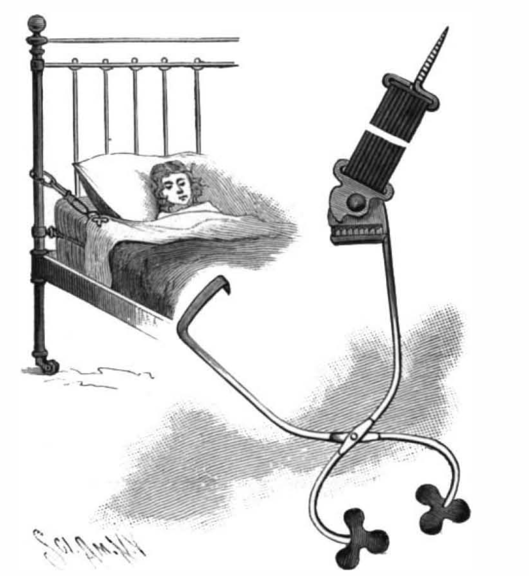


Fig. 3.—1. The field glass open. 2. The field glass closed. 3. Observation from behind a tree. 4. Observation from behind a wall.

THE ZEISS STEREOSCOPIC FIELD GLASS.

A BEDCLOTHES FASTENER.

The illustration represents a simple and inexpensive device for keeping clothes in place on a bed, its construction being such that the gripping jaws will not injure the most delicate quilt or other bed covering, while the jaws are also adapted to be locked at various distances apart to accommodate the different thicknesses of bedclothes, from the lightest to the heaviest. The improvement has been patented by Russell T. Joy, of No. 29 Murray Street, New York City. The gripping jaws at the outer extremities of the two pivoted arms of the holder consist of a series of leaves, preferably trefoil, their edges being smooth and rounded, and one of the arms has at its other end a lateral extension with recess, at the bottom of which are ratchet teeth, a latch pivoted on the extension having a finger adapted to extend across the teeth when the latch is straightened. An elastic band connects the eye of the latch with the head of a screw, with which the device may be connected to a wooden headboard, or, when the bedstead is of metal, a cord with a ring and snap hook are substituted for the screw eye. A pawl on the end of the other arm is adapted to engage the ratchet, when the device is adjusted to hold the clothes, the ratchet and pawl being locked together by straightening the latch, carrying its finger over the pawl.


JOY'S BEDCLOTHES FASTENER.

THE New York Aquarium at Castle Garden is visited daily by 7,000 people, says Science. This large attendance demonstrates the usefulness of such institutions for purposes of instruction and healthful amusement. It is understood that Mayor Strong is in favor of setting aside the land at Bronx Park for the Zoological Park, and it is much to be hoped that arrangements may be carried out without too great delay.

A TWO THOUSAND HORSE POWER TURBINE.

The hydraulic and electrical installations at Niagara Falls offer some of the most interesting engineering features in the world. We illustrate one of the enormous turbine wheels of the new plant of the Niagara Falls Hydraulic Power and Manufacturing Company, which has been recently completed, the machinery being now in operation. The plant was built for the purpose of supplying the new aluminum factory of the Pittsburg Reduction Company and to supply power to other consumers. The company now furnishes power to the Niagara Falls & Lewiston Railroad and the Lewiston & Youngstown Railroad. The water supply for the plant is taken from the upper Niagara River. The water flows through a canal 4,400 feet long, 70 feet wide and 11 feet deep to a basin 400 feet long and 70 feet wide which runs parallel to the high bank.

The water for the new power house is taken from a basin to a forebay, 180 feet long, 30 feet wide, and 22 feet deep, located on the extreme edge of the high bank. Over the forebay is built the gate house which covers the gates controlling the admission of water to the penstocks. There are also two waste gates each 20 feet deep by 8 feet wide, by which the canal may be cleaned at any time. The apparatus for handling these gates was devised by Mr. Wallace C. Johnson, chief engineer of the company, under whose immediate supervision the entire plant was erected. Before each pair of gates are two cast iron cylinders about 8 feet high with pistons; the two ends of each cylinder are connected to a pump driven by an electric motor, by which the oil with which the cylinders are filled is pumped into either end at will, forcing the pistons to move accordingly. The piston rods are connected by an iron beam on which are hooks taking hold of pins on the gates. With this apparatus it is said that a pressure of 100,000 pounds may be maintained.

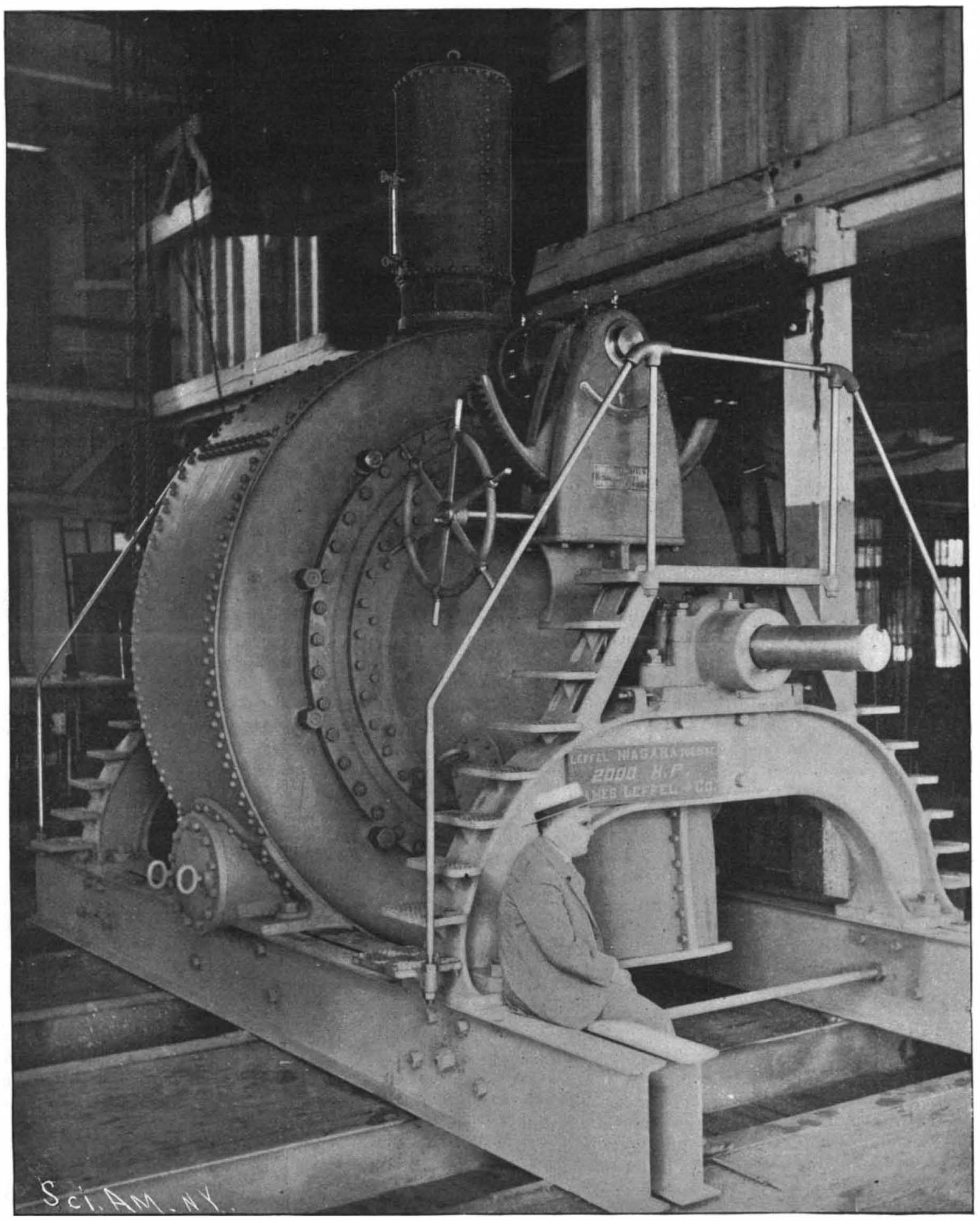
The power house is 180 feet long and is arranged to eventually contain sixteen wheels of about 2,000 horse power each. The wheels work under a maximum head of 218 feet, the highest head thus far used for such a large power. Owing to the fluctuation of the height of the water in the lower river the generator floor of the station was built some 20 feet above the normal water level, and in order to connect the water wheels directly to the generator shafts it was necessary to have them also at the same elevation. It was found necessary to use turbine wheels mounted on horizontal axes to give the necessary speed regulation requisite in a direct connected plant. The penstock runs down vertically 135 feet and is 8 feet in diameter, being built of steel plates. After reaching the bottom of the vertical fall the penstock runs at an angle of 45° and then runs horizontally under the floor for a distance of 70 feet; the size of the penstock is here increased to 10 feet in diameter.

The water is supplied to the turbines from underneath. Valves are provided so that each turbine can be cut off from service if desired. There are at present four turbine wheels installed. They are each of 2,000 horse power and run at 280 revolutions per minute.

The turbines were built by James Leffel & Company, of Springfield, O. Each turbine takes water from a separate 5 foot pipe leading from the penstock. Each wheel weighs about 50 tons and stands on heavy double steel beams spanning the tailrace. The water pressure is 100 pounds to the square inch. The Leffel Company call this wheel their "Niagara type." The turbine shown in our engraving is a double discharge turbine and consists of a large flattened vertical circular casing containing the guide case of the wheel proper. The cylindrical case is 11 feet in diameter and 4 feet long. On the side of this case elbows are fitted through which the discharge water is conducted from the wheels. The shaft passes through these elbows, which are provided with stuffing boxes. On the inside of the elbows lignum-vitæ steps are fastened, against which are concaved rings on the shaft to prevent end motion on the shaft. The wheels are so designed as to prevent end thrust of shaft. The heads of the casing are made of 3½ inch iron castings. The straight or cylindrical part of the casing is made of steel plates ¾ of an inch thick, double riveted to the cast heads.

The runner is made of bronze and iron and is 74 inches in diameter. The rim of the runner is the bucket rim and is cast solid from gun metal bronze. On this rim are two sets of buckets taking water on the face and discharging it at each side of the rim. The bucket ring is bolted to the spokes of the cast iron center, the hub of which is keyed to the shaft of hammered iron, which is 20 feet in length. Surrounding the outside of the runner is a cylinder in which the gates are fitted. The gates are about 20 per cent less in number than the buckets; they are hung on steel pins and open by lifting one edge, so that the direction in which the water enters the wheel is nearly tangential to the runner. Each gate has two arms, which are connected to the ring by means of which they are opened and closed. The wheels operate under a variable head of 210 feet to 218 feet and run at a speed of 280 revolutions per minute. To each end of the water wheel shaft is rigidly coupled a direct current generator capable of generating 560 kilowatts of electrical energy.

The power company have also four turbines of the same type and make. Two of these turbines are of 2.400 horse power, and connect with eight powerful pulp grinders, situated on each side of the wheels and connected directly with them in a manner similar to the generator connections above mentioned.



A TWO THOUSAND HORSE POWER TURBINE.

Two patents have recently been granted to "George Washington," of Brussels, Belgium, for a system of lighting with incandescent burners.

Manufacture of Celluloid.

Celluloid is made by the combined action of pressure and heat, or with the aid of solvents, in that case in the cold, says the Trade Journals' Review. The camphor is dissolved in alcohol, as little as possible, and the solution sprayed through a rose on to the pyroxyline, which must be perfectly dry. A second layer of pyroxyline is added, moistened again with camphor solution, and so on. The gelatinous lump is worked between iron rollers to which it adheres; the layer is slit longitudinally and rolled again. The cakes, 0·4 inch thick, are cut into plates, about 2 feet by 1 foot, which pass for twenty-four hours into hydraulic presses, which are doubly steam-jacketed. The mass is now sawn into plates, which are dried at about 95° Fah. for a week or two, and finally cut into smaller pieces, from which the articles are stamped. Further particulars are difficult to obtain. The writer in the Gummi Zeitung believes, however, that Magnus & Co., of Berlin, pour 100 parts of ether on 50 of collodion wool and 25 of camphor, and stir the covered mass in earthenware vessels with rubber sticks until a homogeneous gelatinous mass is obtained, which is then rolled. At St. Denis ethyl alcohol is said to be used. Apart from dyestuff and other additions the celluloid consists on an average of two-thirds of pyroxyline and one-third of camphor; more camphor imparts an unpleasant smell and impairs the strength of the product. The chemical constitution of celluloid is still doubtful.

The celluloid is generally supplied in rods of 3 feet length, or in plates of 30 inches by 12 inches, of a yellowish color, unless dyed. It cannot be exploded by heat, blows, nor friction. It burns, but the flame can easily be blown out; it leaves an ash skeleton, which continues to sparkle faintly for some time. It is soluble in ether-alcohol, while either of the ingredients alone only attacks the camphor. Concentrated acids and caustic alkalies decompose or carbonize the celluloid. While the finished article is not dangerous, the manufacture is highly so. Various additions to render the celluloid less inflammable are hardly required. The smaller articles are cut ready in the cold, dipped into hot water, bent and shaped, and plunged into cold water again to retain their shape. Larger articles are pressed in heated moulds. If reheated during further operations, the articles lose their shape. The comb manufacture is simpler than with hard rubber. The teeth are stamped with dies, by hand or machinery, and then polished with pumice stone and cold water. The dyes are generally added at the time when the pyroxyline and camphor are mixed. Striped articles are obtained by superposition of plates of different colors and cross cutting of the compressed blocks. Surface dyes may be dissolved in acetic acid or acetic ethers, which slightly attack the celluloid.

Dr. Koch Discovers a New Serum.

Dr. Koch, the eminent German bacteriologist, has telegraphed to Berlin from Cape Town that he is returning home with a newly discovered serum which will lessen the force of rinderpest. In the mean time, he says, he is unable to say whether or not he will be able to prevent animals from being infected with the disease. He has demonstrated that sheep and horned cattle are the most liable of all animals to contract the disease, and that dogs, monkeys, and rodents enjoy complete immunity from it. Dr. Koch telegraphs that he is not going to Bombay to study the bubonic plague which is raging there, despite the fact that he has been asked to head the commission which is to be sent to Bombay for that purpose.

Portland Cement Industry in Belgium.

The most important center for the production of Portland cement in Belgium is the calcareous district of Tournia. Some of the quarries in this district date back several centuries, when they were principally worked for building stones, and for the manufacture of hydraulic lime. The calcareous stone of these quarries, which, according to the United States consul at Brussels, originated the now extensive and important industry of cement manufacture, extends for many miles in length in apparently inexhaustible quantity. Ordinary lime, best hydraulic lime, slow setting (Portland) cement, and quick setting (Roman) are especially products of these immense quarries. Consul Roosevelt says that natural Portland cement is obtained from calcareous stone which is carefully analyzed and dosed, treated in coke heated kilns, and after burning, finely pulverized. Analyses of the calcareous stone found at Tournai show the following result: Silicic acid, 15·75 per cent; oxide of iron, 1; alumina, 3·95; lime, 43·1; magnesia, 0·49; sulphuric acid, 0·5; loss in firing, 35·21 per cent. Before burning the stone presents a fine close grain, and is of a peculiar pasty appearance. Prior to calcination the stone is carefully analyzed to ascertain the exact quantity of lime as well as other chemical properties it may contain. The stone loses about one-third of its weight during the process of burning, which also changes it to a brown tinge. When withdrawn from the kiln, the cement is placed under sheds to thoroughly cool before being ground. After grinding, and before being packed into barrels, it is put into pits and left undisturbed for two months. Natural Portland cement was first produced in Belgium in 1882, and the establishments now engaged in the enterprise have formed a syndicate under the name of "Mutualité Commerciale des Ciments Belges," with headquarters at Tournai. The company sells about 1,200,000 barrels of cement annually. The syndicate has adopted as a trade mark the figure of a hammer. Any firm, however, of the syndicate having a trade mark is privileged to use it. For instance, those firms having the well known "rhinoceros," "trowel," "sword," etc., use them in conjunction with the syndicate trade mark.

Independently of the trade marks of the manufacturers, important buyers of the Mutualité who have labels enjoying a certain reputation are permitted to affix them on the barrels. It is stated that the principal object of this arrangement by the Belgian manufacturers is to warn and protect persons who purchase Roman cement for export without mark or label, and unknown and unauthorized by the manufacturers have Portland cement labels affixed to the barrels at the port of shipment. Roman cement is also made in the Tournai district. It is much cheaper than Portland cement, the selling price being about 50 per cent less than the Portland. It is much employed in Belgium, replacing advantageously a good hydraulic lime. Manufacturers, however, will not guarantee it, as it is made of refuse stone not suitable for the manufacture of Portland cement. It has a natural light yellow color. Cinders are very often added, changing it to a grayish color resembling Portland cement, and also increasing its resistance in a slight degree. This is the product which is purchased by unscrupulous exporters and sold by them marked as Portland cement. This fact is significant and should attract the attention of builders, to avoid disasters such as the unexpected collapse of buildings where first class cement has been supposed to have been employed. Artificial Portland cement was first manufactured in 1872 by a Belgian firm—Messrs. Duffossez and Henry. There are now several important works engaged in its manufacture. Artificial Portland cement is the result of burning a thorough admixture of clay and carbonate of lime in constant proportions, and when dry reducing to finest powder.

Several cements are manufactured by burning natural argillaceous limestone containing varying proportions of clay and carbonate of lime. Some manufacturers rectify the composition of these cements after burning by adding, as required, limestone, slag, etc. Cements are thus produced resembling in chemical constitution Portland cement, but which do not possess its properties, on account of the constituent elements not having been forced into combination by calcination and semi-fusion of the mass. These cements are sold under the name of artificial Portland cements, though in reality they are mixed cements, composed of limestone or slag, possessing none of the qualities or properties belonging to real Portland cement. Artificial Portland cement having an invariable chemical composition must necessarily present a constant character and behavior, and the small differences shown by the assays arise generally from more or less perfection in the burning and grinding, but also exhibit radical changes in their physical and chemical constitution on account of the varying proportions of their component parts. Cement may be submitted to a large number of tests for the purpose of ascertaining its qualities. The tests relate to (1) regularity of composition; (2) fineness of grain; (3) gravimetric weight; (4) specific gravity; (5) time of setting; (6) resistance to tensile, compressive or shearing strains and cohesive strength, either when pure or mixed with sand; (7) uniformity of volume or expansion; (8) resistance to frictional wear; (9) expansion; (10) impermeability, etc. To be considered of good quality, the cement must give a satisfactory result to the group of tests to which it is submitted. Thus, if properly proportioned, it should, for a given fineness of grain, have a maximum of weight and specific gravity, fulfill the required conditions of setting, and show the minimum of resistance to strain required within a given time.—Journal of the Society of Arts.

The Clay Eaters.

Yellow clay as a daily food is what many of the people of Winston County, Ala., live and thrive on, says the Atlanta Constitution. The county of Winston is in the northwestern portion of the State and is sparsely settled, its population being poor and appearing to be eking out a mere existence. It is only within the past few years that the amount of taxes collected from the entire county amounted to $1,000. Until 1888 Winston was forty miles from the nearest railroad and the county court house twenty miles further. Houses of worship and those for eductional purposes are few and far between. A majority of Winston's population live in small log cabins of the rudest kind and eke out a miserable existence by farming, hunting, and fishing.

Their farms, or patches, as they call them, are small clearings around their cabins, and are seldom more than a few acres in extent. Their crap (as they invariably say) consists of corn, pease and potatoes, and a few who are fortunate enough to own a horse attempt to raise a little cotton. The land is very poor, and as the crops receive little work, the yield is always small. A few hogs are raised, but the majority depend on the country stores for the few strips of bacon they eat during the year. Here in this county, though, the moonshine stills flourish as the green bay tree. In almost every cave and on every little brook among the hills may be found a still whose undertaker's delight is produced by the soft light of the moon and where Uncle Sam fails to get his pull-down of 90 cents on the gallon. These people are too far from market to sell their corn for money, but they can convert it into good, straight liquor, carry it in kegs or jugs to the more thickly settled neighborhoods a few miles away and obtain a few dollars in money, some tobacco, coffee, and snuff for the women folks. Men, women, and children are all slaves to the tobacco habit. The women chew, smoke, and dip snuff, but "dipping" is generally a Sunday luxury, as snuff is hard for them to get.

The interior of the cabin of the clay eater is rude in the extreme. It is usually built of small pine logs, from which the bark is sometimes removed. There are no windows, and sometimes only one door. In winter the cracks between the logs are filled with rags and clay or thin boards nailed over them from the outside. In summer these cracks are opened, in order to allow plenty of fresh air to enter. There are no pictures on the walls, no ornaments of any kind, and often no furniture worthy of the name. Of these are bedsteads, and they are of the crudest kind, made by the head of the family, with no other tools than a saw, ax, and hammer. Usually the cabin is too small for bedsteads if the family is large, and they sleep on quilts and mattresses spread on the floor, often the ground. The entire family, often ten or more persons, eat and sleep in the same room, and the cooking is done on one fireplace, the utensils consisting of a frying pan, kettle, oven, and a pot. All modern conveniences are almost unknown. Few families ever see a newspaper, and there are but few of the people who can read. Their parents before them could not, and their children are growing up equally ignorant. Strange to say they do not believe in "book learning." If the head of the family is a member of the church, probably a cheap Bible may be found in the house, but they never hear it read except when a traveling preacher comes along and stops for dinner or stays all night. When the writer was in Winston County last year he heard a man of God read from the Great Book, and when he read "Jesus Christ died to save sinners," the good old motherly woman moved the cob pipe from her mouth and in utter astonishment remarked: "Is that so? I allus told Bill we'ud never know nuthin' 'less we tuck the paper."

The clay eaten by these people is found along the banks of the small mountain stream in inexhaustible quantities, and is of a dirty white color usually, sometimes a pale yellow. It has a peculiar oily appearance, and the oil keeps it from sticking to the hands or mouth. When dry it does not crumble, and a few drops of water will easily soften it until it can be rolled into any shape desired. The clay is almost without taste, but evidently possesses some nourishment, as these people declare they can subsist on it for days without any other food whatever. They place a small piece in the mouth and ho'd it there until it dissolves, and is swallowed in small quantities at a time. The quantity eaten at one time varies from a lump as large as a pea for a child or beginner to a lump as large as a man's fist for those who have eaten it for years. These people eat the clay with a ravenous relish, and the only bad effect seems to be the peculiar appearance it gives the skin of those who become addicted to the habit. The skin turns pale, so pale, in fact, as to give the face the pallor of death, and then later on it turns a sickly pale yellow, a color closely resembling some of the clay eaten. Children who become addicted to clay eating grow old, at least in appearance, prematurely, and their faces lose forever the bright glow of youth and health. Strange as it may appear, there is little sickness among the clay eaters, and they live as long as the average mankind, this proving that clay eating is not fatal in its effect.

It may or may not be the result of clay eating, but these people are as superstitious as the followers of a voudoo. They have signs for everything, and almost worship the moon. Corn is planted when the moon is full, and potatoes on the dark of the moon. They will not start on a journey or begin a job unless the moon is right, and they foretell storm and disaster by the appearance of the moon. If one end of the new moon is lower than the other, it will rain before the moon changes again, and if the new moon is level, there will be no rain until another change occurs. It might be remarked that the clay eaters are often as successful in their prognostications as the average manipulator of the weather bureau. For an owl the eater has a holy dread. The hooting of an owl at any hour after 8 o'clock in the evening and until nightfall the following day is an omen of bad luck. If heard in the quiet hours of night and answered by the howl of a sleepless canine, it is a sign that one of the family will die before many moons. As soon as the hoot of an owl is heard a chair is overturned. If the hooting ceases at once, the threatened danger has been warded off for a time, but if it continues there is weeping and wailing in the home of the clay eater. The howling of a dog at night is also an omen of ill luck, but it is not a sign of approaching fatality unless it is in answer to the hoot of an owl. When a screech owl lets forth one of its horrible and bloodchilling sounds, the women folks reach their hands up the chimney and get a handful of soot. A screech owl near the house is a sure sign of death.

With the tenacity of ignorance these people cling to their filthy habits, traditions, and superstitions; of modern inventions and customs they have never dreamed, and they would ridicule the man who told them the world is round. Perhaps in time they will disappear with the onward march of civilization and enterprise.

The Brambel Engine.

In our issue of January 30, we published an article on the Brambel rotary engine, in which article we reproduced the claim of the patent and its drawings. As we failed to see anything startling in the invention, as its claim, from the multiplicity of its elements, was of limited scope, and as the engine involved no discernible principle that would make it an operative device, we formed a most unfavorable opinion of the widely exploited device and of the methods used for giving it the publicity which it has attained. Since that paper was published other accounts have appeared in the press, and all go to verify our original opinion. Some pains have been taken to verify the published personnel of the capitalists and of their representatives without success. The transfer of any money from the capitalists to the inventor has not been proved, in spite of the fact that a facsimile of a check made out to Brambel, covering several millions of dollars, was published in one of the exemplars of the new journalism. The story is what we pronounced it nearly a month ago—a hoax.

The name of the town where the story originated is a curious and suggestive feature of it. Sleepy Eye would seem well adapted to express the status and nature of the credulous individuals who put trust in the story. But no such person, we are confident, has yet been proved to have invested very deeply in what may be termed the Sleepy Eye engine. If so, we fear that the Brambel with which such invention will have come in contact may treat them as the bramble bush in Mother Goose treated the man who was wondrous wise—the Minnesota Brambel may put out his Sleepy Eye.

The attempt to boom this invention indicates a system of operations greatly to be deprecated in the interest of meritorious inventions. Good wine needs no bush, a good invention needs no Brambel. Capital is ready and willing to take up a good invention, but millions of dollars are not invested in things of the type of the curious invention from the curiously named western town.

SINCE the completion of the great locks at the Cascades in Oregon, a few weeks ago, boats can pass from the mouth of the Columbia River to the Dalles, 230 miles. In a short time the boat railroad from the Dalles to above the Celilo Falls, nine miles, will be finished, and boats will be able to go up the river 560 miles without change. Heretofore it has been necessary to transfer cargoes at the Cascades and at the Dalles.

Science Notes.

Governor MacGregor discovered on his recent tour through British New Guinea several new varieties of birds, including a new kind of bird of paradise. On Mount Scratchley, 11,000 feet above the sea, larks were found, and vegetation corresponding to that of a temperate zone.

Prof. Galileo Ferraris died at Rome February 7, 1897, aged fifty years. He was principal and also professor of applied physics of the Museo Industriale of Turin, and was a member of the Italian Senate. He made important contributions to electricity, studying especially the phenomena of alternating currents.

The results of the quinquennial census of France, taken on March 29, 1896, show a population of 38,518,-975, an increase of 125,027 during the five years. The towns having more than 30,000 inhabitants show an increase of 320,000. Most of the agricultural districts, with the exception of Brittany, show a decrease.

A French chemist has discovered a purely chemical standard for determining the bread-making properties of flour. In a paper presented to the Académie des Sciences he asserts that flour containing one part of glutenine to three parts of gliadine produces the best results for digestion of the bread and for bakers' purposes.

In an infringement of patent case recently heard in the courts at Trenton, N. J., in which the complainant company are makers of a water nozzle, the defendant answers that the essential and substantial features on which the patents are based were known, among others, to "One Heron, now deceased, but formerly of Alexandria, Egypt, living at said Alexandria and elsewhere, 1,000 B. C."

Four essays presented in competition for prizes under the Hodgkins Fund of the Smithsonian Institution are now published and distributed: Argon, a New Constituent of the Atmosphere, by Lord Rayleigh and Prof. Ramsay; Atmospheric Actinometry, by Prof. Duclaux; The Atmosphere in Relation to Human Life and Health, by F. A. R. Russell; and Air and Life, by H. De Varigny. The first essay justly received the great Hodgkins prize of $10,000. All the authors are Europeans.

Lord Lister, in a communication to the British Medical Journal, announces that he has the profound satisfaction of being able to state, on the authority of the India Office, that the Bombay government intend to make use of the services of M. Yersin in the treatment of persons suffering from plague. M. Yersin is now on his way to the stricken region to give a full trial to his method, and Lord Lister has learned through another channel that before the middle of February the serum treatment will probably have begun in Bombay.

The French maneuvers in the Alps had some unexpected results, says the Army and Navy Journal. It was the fixed opinion of the French staff that the Alps were impassable, but on two occasions the corps representing the invader outmaneuvered the defending force and forced its way inland by some of the minor passes. These points were first near the Tenda pass and the Authion peak between the two parallel basins of the Roya and Vesubja. The second instance was the more glaring, for it was found that a hostile force could advance, entirely evading the strong fortresses of Briançon and Tournoux. Orders have been given to strengthen all these weak points, but this will necessarily be a work of time, and some of the work cannot be commenced before next spring.

A calculation is given in a bulletin of the United States Weather Bureau, says the American Electrician, "showing the immense quantity of energy expended in the formation of clouds. It is estimated, on the basis of the annual fall of water as rain or snow in the United States, that the work done in raising the rainfall to the clouds is equivalent to 1,920,000,000 continuous horse power, or the work of 5,000,000,000 horses toiling ten hours a day—perhaps a thousand times as many horses as there are in the United States." We wonder what the energy expended in America in reckoning out such useless figures is equivalent to, says an English contemporary. Though such computations may be valueless from a practical point of view, still they are interesting, and if accurate give no just occasion for comment.

Mr. Clement Wragge, who organized the twin meteorological observatories on the summit and at the foot of Ben Nevis some years ago, and who is now the government meteorologist of Queensland, aims at the establishment of similar twin stations at outstanding points in the southern hemisphere, partly with the view of comparing the high level with the low level results at these points, and further with the view of comparing these results with those obtained at corresponding latitudes in the northern hemisphere. There has been for some years a meteorological station on Mount Wellington, in Tasmania, which Mr. Wragge organized, and Mount Wellington is the Ben Nevis of the Antipodes. Its latitude is some degrees lower than that of its northern prototype, but its elevation (4,120 feet) is within 250 feet of being the same. The permanent establishment of twin stations on Mount Wellington is Mr. Wragge's first aim; but he also wishes to have high level stations at several points in the Australian Alps, such as Mount Cork (13,000 feet).

Archæological News.

A Madonna and Child which is believed by many critics to be by Cimabue, the master of Giotto, has been discovered in London. It had been for thirty-five years in the possession of Canon Harford, of Westminster, who had obtained it from the Balgano family in return for his assistance in disposing of their collection. The picture is painted on a panel covered with a chalk preparation and is painted over with oil with the exception of the two figures. Sir E. J. Poynter, the new president of the Royal Academy, believes in its genuineness, but doubts on the subject will not be dispelled until it has been examined and certified to by some critic of the Morellian school. If genuine, the discovery is of the utmost importance, as Cimabues are exceedingly rare.

It is curious that the very oldest business in the world has continued on, of course, in a rapidly diminishing quantity, but still kept on, from the time when man first fashioned a weapon out of flint up to to-day. Where man in the Neolithic age, thousands on thousands of years ago, dug his pit and found his flint, and there fashioned it, in the identical place the same work is carried on to-day at Brandon by what is called the flintknapper. Under the chalk lies the flint, and pits are dug and short tunnels constructed. The old workings of the remote past are close to the present ones. The mystery of arrow making, using flint as a material, has been solved long ago. By practical work it is found to be much less difficult than it was at first supposed, and that it can be quickly done. Modern processes only differ inasmuch as we have more efficient tools. The knapper puts a leather pad on his knee and so splits it. What his business is, is to make flints for old muskets and guns, such as are used in the most remote parts of the world. India, China, and South America still use flint-lock guns. Perhaps never will this, the oldest of guilds, give entirely over its flint working. The past ever accompanies the present.

The report of Prof. R. B. Richardson, the director of the American School, shows that the excavations at Corinth in 1896 were of more importance than was supposed. They occupied nearly three months, and at times one hundred men were employed. There was nothing but the ruins of a temple to suggest a place for operations. The first trench disclosed thirty-five Ionic columns used as foundations for a later building, says the Architect. In the second trench were fourteen rock-cut graves, with skeletons in most of them, and many vases of common red ware. Twenty-one trenches were dug altogether; but it was not until the eighteenth was made that five flights of steps, innumerable lines of seat foundations, and two seats in position were found, indicating the Greek theater, upon which had been erected a Roman theater with seats of steeper pitch. In the upper part of the theater were uncovered many terra cotta figurines. Other trenches brought to light a huge drum and the broad pavement with a water channel on each side, these indicating the old agora or a broad passageway into it. The old temple is supposed to have been dedicated to Apollo rather than to Zeus. The chief find in sculpture was a group representing the youthful Dionysus between Pan and a nymph. Nineteen vases grouped about skeletons were also discovered. The vases are unbroken, of interesting shape, and very primitive in appearance. The director suggests laying down a track and dumping cars for next season's work at Corinth, and estimates at $5,000 the cost of next season's excavations.

Everybody associates Lord Nelson's name with the battle of Trafalgar, says the Churchman. How few associate it with the Elgin marbles! Yet the fruits of Trafalgar are gone, but the Elgin marbles remain. They remain not only the highest works of art, but articles whose mere cost value is at the present moment reckoned in millions. Their possession is due primarily to Lord Nelson, whose victory at the Nile began the ruin of the French rule in Egypt, and the French influence with the Sublime Porte. Turkey seized every opportunity to prove her good will toward England, and at that time Greece was a province of Turkey. Lord Elgin, who was then English ambassador at Constantinople, finding that nothing was refused which was asked, and being an enthusiast in Greek art, obtained permission to rescue from complete destruction and oblivion the noble remains of sculpture and architecture scattered throughout Greece, which the French had been removing to the Louvre at Paris for some years previous. While the French had been removing, the Turks had been destroying, for it was found, on incontestable evidence, that many of the statues from the Parthenon at Athens had been pounded up for mortar and used as cement. However, Lord Elgin worked assiduously for years, and completed the salvation of the statues of Phidias. But Lord Elgin himself owned that he never would have been allowed to remove or even dig for one stone had it not been for the victories of Nelson. Few are aware of this.

The Signs of Longevity.

Every one is interested in the question of long life as applied to himself, and all facts bearing on it are noted with becoming feelings of self-congratulation or otherwise, says the Medical Record. It is the staying power that is in demand, backed by an inherited and reserved vitality of resistance against the usual evils to which all flesh and other perishable things are subject. The law of heredity, which our life insurance companies understand so well, is at the bottom of all calculations as to whether a particular man or woman is wound up for seventy years or will run down at twenty or forty years. Aside from this testimony, there are certain physical qualities which have great weight in determining the result of the struggle against a conspiring environment. An oak has one configuration, and a cedar, pine, or mullein stalk another. It is the proper recognition of such distinctions that aids physicians in their prognosis and turns the balance against apparently desperate chances. At a recent meeting of the Academy of Science, Mr. F. W. Warner, in speaking upon the subject of biometry, offered some very interesting data, which are in the main true. He said:

Every person carries about with him the physical indications of his longevity. A long-lived person may be distinguished from a short-lived person at sight. In many instances a physician may look at the hand of a patient and tell whether he will live or die. In the vegetable as well as in the animal kingdom, each life takes its characteristics from the life from which it sprung. Among these inherited characteristics we find the capacity for continuing its life for a given length of time. This capacity for living we call the inherent or potential longevity. Under favorable conditions and environment, the individual should live out the potential longevity. With unfavorable conditions this longevity may be greatly decreased, but with a favorable environment the longevity of the person, the family, or the race may be increased.

Herein are presented the two leading considerations, always present and always interdependent—the inherited potentiality and the reactionary influences of environment. He continues:

The primary conditions of longevity are that the heart, lungs, and digestive organs, as well as the brain, should be large. If these organs are large, the trunk will be long and the limbs comparatively short. The person will appear tall in sitting and short in standing. The hand will have a long and somewhat heavy palm and short fingers. The brain will be deeply seated, as shown by the orifice of the ear being low. The blue hazel or brown hazel eye, as showing an intermission of temperament, is a favorable indication. The nostrils being large, open, and free indicate large lungs. A pinched and half-closed nostril indicates small or weak lungs.

These are general points of distinction from those of short-lived tendencies, but, of course subject to the usual individual exceptions. Still, it is well acknowledged that the characteristics noted are expressions of inherent potentiality, which have been proved on the basis of abundant statistical evidence. Again, he says truly:

In the case of persons who have short-lived parentage on one side and long-lived on the other side, the question becomes more involved. It is shown in grafting and hybridizing that nature makes a supreme effort to pass the period of the shorter longevity and extend the life to the greater longevity. Any one who understands these weak and dangerous periods of life is forewarned and forearmed. It has been observed that the children of long-lived parents mature much later and are usually backward in their studies.

Such observations are of the highest importance.

Why Physicians Should Shave.

It may be claimed by some, writes Dr. W. A. Hockemeyer to the Medical Brief, December, that "the beard is provided by nature, and should be allowed to remain. So it may be with the layman, but when with the faculty it might prove a serious means of contagion, it were better that no chances should be taken. In listening to the action of the heart, or in making other examinations, the face of the examiner must necessarily come into direct contact with the person or clothing of the patient, and a bearded face would be much more liable to be affected thereby than the cleanly shaven skin. Dr. Marion Sims was under the impression that disease had often been conveyed by this means, and was always a firm believer that the less the face was encumbered, the better it was for both the doctor and patient. There is, beyond all that, this fact which cannot but be generally admitted: the perspiration of summer and the frosted breath of winter, or the dampness from rain in all seasons, are not pleasant things for a doctor to carry into a sick room. In winter he may divest himself of his overcoat and hat in the hall, but the beard, with the effects of the outside atmosphere, cannot be so easily laid aside, and oftentimes, especially if the call be a hurried one, the patient may become nauseatedly aware that the doctor was interrupted in the enjoyment of his pipe.

A GIFT OF PHILANTHROPY TO SCIENCE.

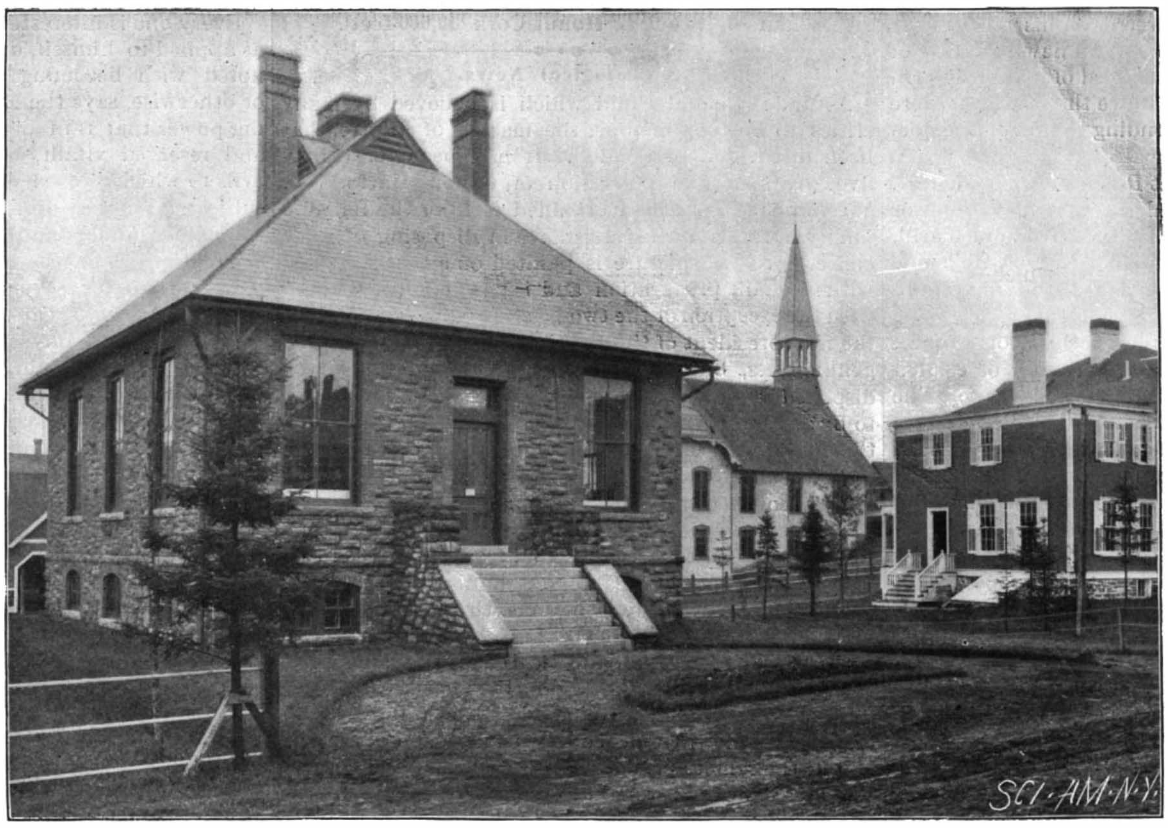
THE SARANAC LABORATORY FOR THE STUDY OF TUBERCULOSIS.

BY E. R. BALDWIN, M.D.

This institution is situated at Saranac Lake, New York, in the heart of the Adirondack Mountains, and was presented by the late George C. Cooper, of New York, to Dr. E. L. Trudeau, whose name is familiar to visitors in this healthful region. The laboratory, which is the first of its kind, has no commercial features, but is devoted solely to researches in tuberculosis. In this it is exceptional, being equipped for this special work, and meets an urgent demand in this country, where few facilities are available for such research, and at a time when medicine is hopeful for the conquest of all infectious diseases; for only by such research in laboratories can we expect to accomplish this end and lessen empiricism.

The importance of interlinking research and treatment in tuberculosis had been evident to Dr. Trudeau from the earliest days of the Adirondack Cottage Sanitarium for pulmonary diseases, and with such improvised apparatus and meager quarters as were then available, a series of researches had proved the importance of such work and given promise of beneficial achievements. Mr. Cooper, an intelligent observer of the practical work of the sanitarium—a charity which also received his benefactions—soon realized that more adequate facilities for investigations here and upon this special theme would give rich promise, not only of important achievements in science, but also of direct and immediate benefit in the practical aims of the sanitarium. This broad conception of the importance of establishing a close relationship between research and practice soon crystallized into a purpose to secure such a relationship here upon a firm and lasting basis. This beneficent and clearly conceived purpose of Mr. Cooper was carried out with characteristic absence of ostentation, and is only one example of his liberality in the cause of education and in the relief of suffering. His aim was realized during his lifetime, and is an expression of the spirit manifest in the family which gave to New York the Cooper Institute. Mr. Cooper was not satisfied with the mere establishment of the material facilities for investigation, which his gift of the laboratory afforded, but, in association with Mr. John Garrett, of Baltimore, gave a fund sufficient to carry on researches for several years, while a brother of the latter, Mr. Horatio Garrett, now deceased, provided a fund for a library.

The Saranac Laboratory, as will be seen by the exterior view, is a substantial, fireproof, stone building, located near the Adirondack Cottage Sanitarium, which is a well known resort for consumptives. It consists of one story and a basement. The interior is finished with white enameled brick walls, which permit of easy disinfection, while being simple and attractive. The laboratory, as will be noticed by the illustration on the front page, is spacious, has high ceilings, perfect light, and ventilation through dust filters; is provided throughout with electric lights, abundant water supply and hot water heating apparatus. This room contains the principal bacteriological and chemical apparatus. At the extreme end of this room, on the right, will be noticed one of the incubators, a nearer view of which may be seen in our large upright illustration. On the left is seen a private workroom in the distance.



SARANAC LABORATORY FOR THE STUDY OF TUBERCULOSIS.

Another view on the accompanying page shows the chemical apparatus and the position of the dry and steam sterilizers in the inclosed hood; also a sink and work table. On the upper front page is pictured a larger view of the flasks containing cultures of the tubercle bacilli growing on the surface of fluids, while the tubes on the right illustrate its growth on slices of boiled potato and agar. The incubator, or culture oven, is a metal chamber surrounded by a water jacket and thick asbestos covering, insuring a uniform temperature, maintained by means of a lamp placed under the thermostat. Overheating is prevented by an electrical alarm controlled by a thermometer. The whole is inclosed in an outer glass case with doors.

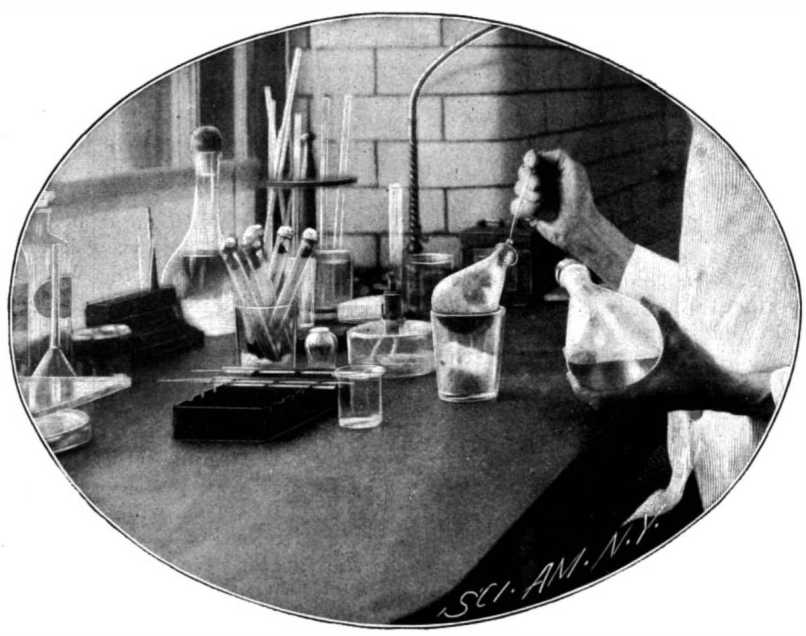


Fig. 4.—TRANSPLANTING CULTURES OF TUBERCLE BACILLI

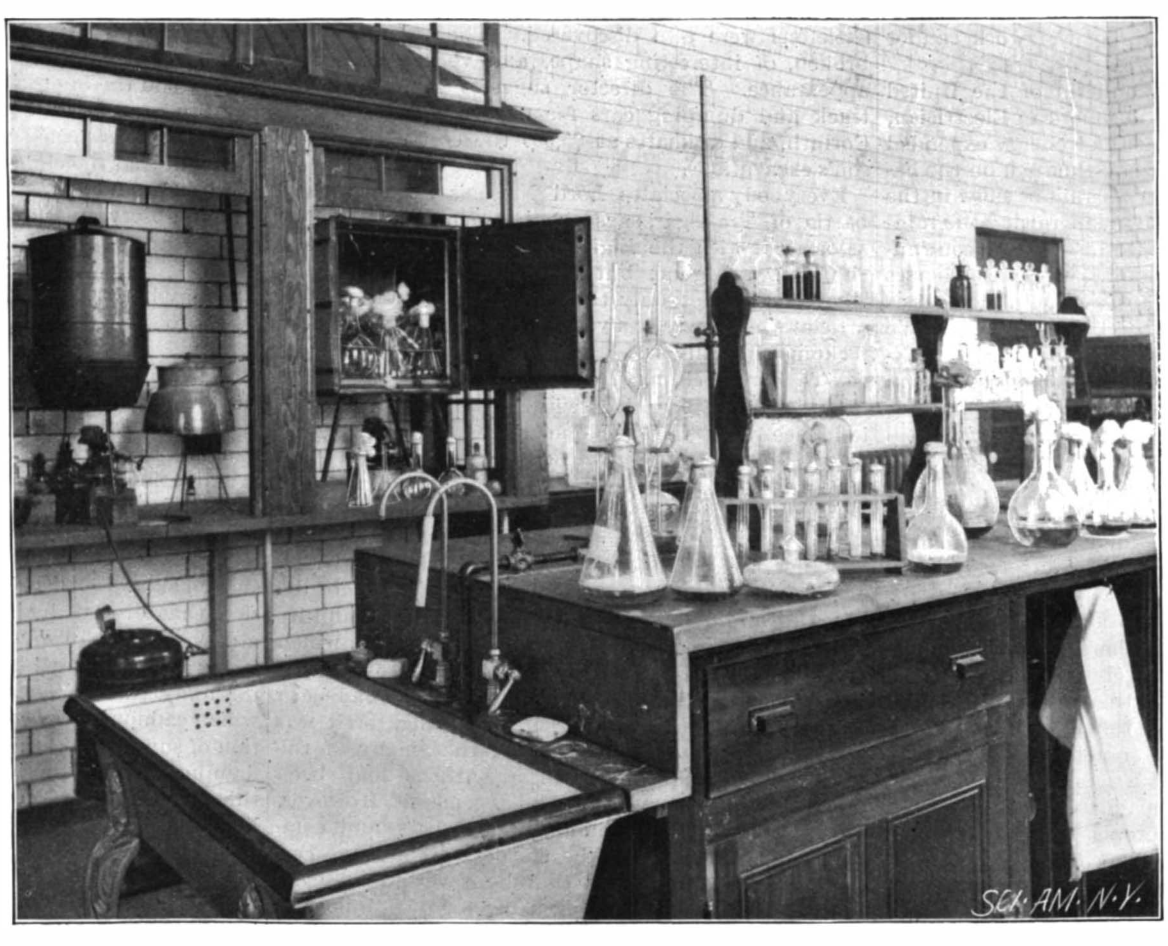
There are also two private workrooms, besides a library specially devoted to the literature of tuberculosis, a room for animal examinations, and a room for living animals under observation in the basement.

It is by the study of such growths or cultures that the life history of this sinister germ is made out and a clear understanding is obtained of its action in the human body. Through these cultures, also, studies can be carried on upon various agencies which it is hoped may be beneficial in the treatment of the disease.

The bacillus of tuberculosis is naturally treated with respect in this laboratory. Precautions against infection are constantly employed in handling flasks and other receptacles containing the bacilli. The same is true of the animals, whose cages are constructed of galvanized iron, so that they can be soaked in a tank of strong lye after being cleansed. The animal room, as well as the examination room, is occasionally flushed out with the hose, and sterilization by boiling is practiced on all apparatus before cleansing.

Guinea pigs and rabbits are chiefly employed for experimental purposes, and animal tests of many old and new remedies used in the treatment of tuberculosis form especially interesting branches of the work. New methods of treatment can be properly controlled only in this way, as it is impossible to secure uniform conditions in man; and experience shows that deductions made from animals very generally apply to human beings. This feature renders the laboratory valuable to the neighboring sanitarium in thus bringing scientific methods of diagnosis and treatment to the aid of the patients.

The equipment of the Saranac Laboratory provides for a great variety of work on the subject of tuberculosis, and, although so much has been revealed through the labors of Koch and others, there still remains a wide field unexplored in this



SARANAC LABORATORY—INTERIOR MAIN ROOM.

too familiar disease. There are many problems yet to be solved relating to public and private hygiene, including the spread of tuberculosis in man and domestic animals. There are many less practical but still highly interesting questions concerning the biology of this parasite, its variations in virulence and poisonous products; and, furthermore, the possibilities of alteration by changing its growth conditions.

There is great need for educational work in the matter of infection in tuberculosis, and it may be pertinent here to mention briefly some facts relating to it which have thus far been amply demonstrated:

1. The sputum of consumptives is the source of infection in by far the greater proportion of cases.

2. The breath alone does not contain the bacillus.

3. Sunlight with drying destroys the vitality of the bacillus in twenty-four hours' exposure.

4. The bacilli in sputum may preserve vitality for months, when deposited in badly lighted and ill ventilated places.

It is worthy of note that victims of the disease usually have an acquired or inherited susceptibility. Direct inheritance of pulmonary tuberculosis is probably extremely rare.

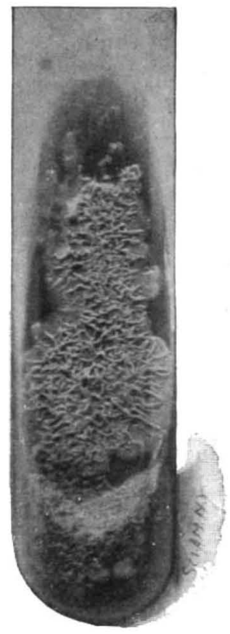
Fig. 1 is a reproduction from photographs by Edward Leaming, M.D., made at the College of Physicians and Surgeons, New York, of bacilli magnified 1,000 diameters, found in the sputum of a person affected with tuberculosis. The minute elongated black specks, sometimes arranged to form the letters V and X, are the bacilli, and are distinctive in shape, to be readily detected and recognized wherever seen when properly stained.

It can easily be comprehended from the photograph how these little parasites can float about in dust when the expectoration, carelessly deposited, is dried and pulverized.

The cultures of tubercle bacilli are comparable to the hothouse cultivations of many plants, though they require more delicately combined conditions for their development. They must have moisture, absence of light, and a fairly uniform temperature, near to that of the human body. A first culture of the bacillus tuberculosis is one of the most difficult of all the pathogenic germs to obtain; failures often following attempts to grow it from a tuberculous animal, or—what is still more difficult—directly from the sputum of a consumptive. Such sputum usually contains numerous rapidly growing bacteria besides the slow growing tubercle bacillus, so that the tubes become contaminated easily long before the latter gets a start.

It is customary first to inoculate a guinea pig or a rabbit with a small particle of the expectoration, which, unless the animal shortly dies of septicæmia, quite uniformly results in death from tuberculosis after six weeks or within three months. From the diseased organs, and especially from the lymphatic glands, bits of tissue containing the bacilli are obtained entirely free from other germs which were present in the inoculated sputum, but were unable to develop in the animal after a short time, leaving the field clear, so to speak, for the tuberculosis germ. These bits of tuberculous tissue are transferred on sterilized forceps and platinum needles to tubes of hardened blood serum, upon the surface of which they are rubbed.

Koch first succeeded in growing this germ upon coagulated blood serum, which furnishes nutriment most nearly like the animal tissues, their natural pabulum.



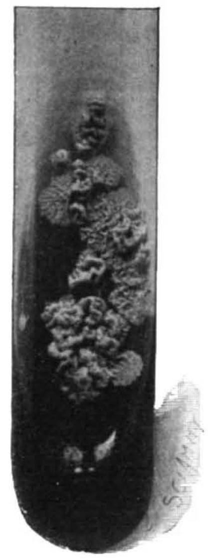


Fig. 2. Fig. 3.
TUBE CULTURE B. TUBERCULOSIS—CULTURE ON AGAR AGAR.

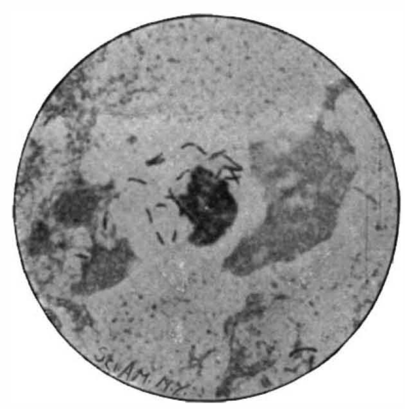


Fig. 1.—TUBERCLE BACILLI IN SPUTUM×1000 DIAMETERS.

It is, in fact, very difficult to start cultures on any other substance except potato.

Figs. 2 and 3 are excellent photographs showing the growth of these bacilli on agar agar or Japanese gelatin.

After the artificial cultivations are started on serum or potato, it becomes fairly easy to continue rich growths on agar, beef broth, and even upon solutions of salts containing phosphates, sulphates, carbonates and glycerine. This is done by transplanting from an actively growing culture a particle or flake of the crust-like mass of germs to sterilized tubes or flasks of fresh media. The details of this process are seen in Fig. 4. Large numbers of fluid cultures are needed in the study of the growth products of the bacillus tuberculosis.

Tuberculin is made from flasks of bouillon grown six weeks, during which time the fluid becomes charged with the soluble products of growth. The original tuberculin of Koch, which caused so much excitement five years ago, consisted of such cultures simply evaporated to one-tenth their volume, and filtered free of bacilli.

Tuberculin, or the "lymph," is still used as a remedy in a very limited way, in spite of the condemnation it receives as a consequence of unfortunate results in the past. A few selected cases are undoubtedly benefited by it, but by far the most important sphere of usefulness for tuberculin is for the diagnosis of tuberculosis. Its extensive employment for this purpose in cattle needs no mention, as its value is well established.

The use of tuberculin for detecting early tuberculosis in human beings is becoming more general, though the odium that was cast on it during its indiscriminate use four or five years ago still clings to it in the minds of many physicians. The striking effect of this fluid is in selecting the hidden disease and causing local congestion therein, while at the same time producing constitutional disturbances such as fever, malaise and muscular pains, all of which soon disappear. No effect follows in the great majority of persons when tuberculosis is absent.

Inasmuch as the successful arrest and cure of tuberculosis depend upon its early detection, we can no longer neglect any aid that laboratory methods have already revealed. If these alone are considered, we owe a great debt to Koch and his brilliant work.

There are three invaluable methods of diagnosis in obscure cases, which in the order of frequency of application are:

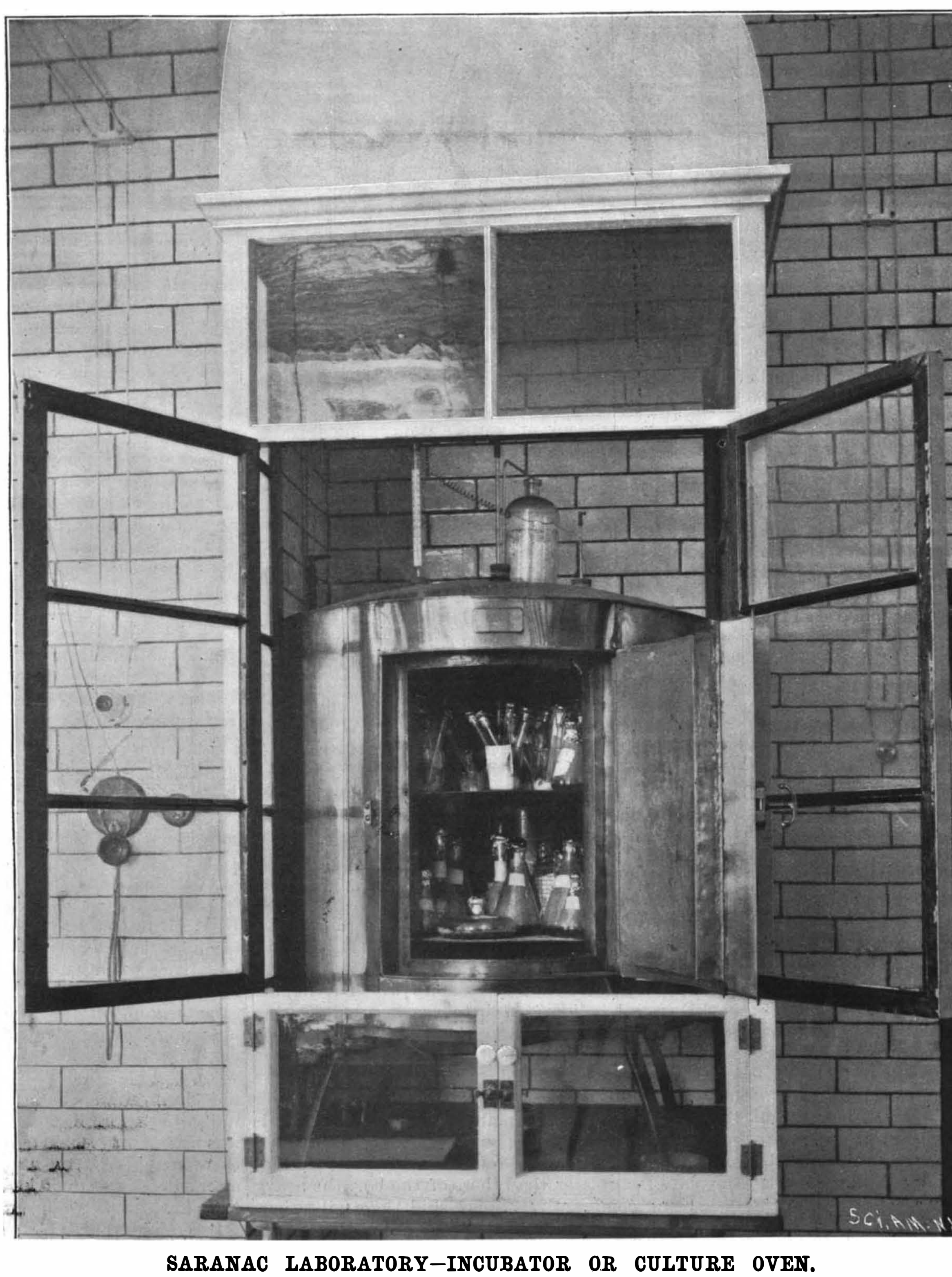
1. The microscopical examination of sputum and other secretions for the presence of tubercle bacilli.

2. The inoculation into susceptible animals of suspected sputum, etc., in which the microscope fails to reveal the bacilli.

3. Tuberculin injection, where the first two methods fail, or there is no sputum or other discharge available for examination.

When the disease is present, it can be detected in some one of these ways with almost absolute certainty, even in its earlier stages.

Probably the most important problem or line of research engaging the attention of laboratory workers in medicine at present is the subtle one of immunity from or acquired insusceptibility to tuberculosis and other diseases. We cannot yet say whether we shall ever by artificial means be able to protect the human body against the invasion and spread of the bacillus tuberculosis, yet we may cherish this possibility in view of the recent specific antitoxin so unquestionably useful in diphtheria. The discovery of a specific remedy for tuberculosis has always been the



SARANAC LABORATORY—INCUBATOR OR CULTURE OVEN.

dream of enthusiasts, and it may be that ere long research will develop methods for the production of antitoxic serum efficacious in this disease. Experiments in this direction have thus far led to results not without promise, but as yet without any demonstrated practical value. It seems reasonable to expect the development of some means of neutralizing the poisonous products of the bacilli in the body, as has been done in diphtheria, even if a complete cure be not thus effected.

When we consider the process accompanying natural recovery from consumption, which we call increase in resistance, the loss of which constitutes the main factor in susceptibility, we must conclude that the success of a specific remedy involves many influences in our complex civilization which raise or lower bodily vigor; and that the permanence of any immunity produced must also depend on these factors. An open-air life in a favorable climate, combined with nutritious food, accomplishes more surely the prevention and cure of consumption than any remedies yet known, though the latter may assist. The world will doubtless cling to such verities until science shall point out better methods, discovered step by step in laboratory study.

While state and national authorities are concerned with varying degrees of interest and success in furthering the economic interests involved in the prevention of diseases among cattle, the human animal in this country has as yet certainly been largely ignored in official measures for the public weal. Among the multitudes of safeguards now put about life, can we afford to neglect studies which look to the control of this widespread disease in man?

We are indebted to Mr. G. W. Baldwin, the photographer of Saranac Lake, for the excellent photographs from which our illustrations are made.

The New Navy Bill.

Whatever regret may be caused in some quarters by the fact that the new navy bill as reported by the House Naval Committee makes no provision for the addition of any new battleships to those already built or building, one cannot but rejoice that the changed aspect of our international relations is in some measure the cause of the omission, the sense of the pressing need for an immediate increase in the navy having moderated with the return of tranquillity in our foreign relations.

The last naval bill with its large appropriation of over thirty millions was passed at a time when the political sky was overcast and possible complications with England and Spain were threatening. The intervening twelve months, thanks to skillful and well directed diplomacy, have seen a great clearing of the air, the effect of which is undoubtedly seen in the provisions of the present bill.

It is true that, as reported by the sub-committee, the bill recommends an even larger appropriation than last year, the total being $32,165,234; but it must be borne in mind that although $13,146,155 of this sum are asked for "increase of the navy," and for "armor and armament," a large proportion of the latter sum is for carrying on the construction of the five battleships which have recently been authorized and are now in the early stages of construction. There is no doubt that the fact of our having in all six first-class battleships under way has also tended to reduce the recommendations for new ships. Including the Iowa, now nearing completion, the battleships under construction have an aggregate displacement of 57,580 tons, and as will be seen from the details given below they will constitute a homogeneous fleet of practically the same size, speed, and fighting power:

The Iowa, of 11,300 tons displacement and 16½ knots speed, carrying four 12 inch, eight 8 inch, and six 4 inch guns besides 26 smaller guns.

The Kearsarge and Kentucky, of 11,500 tons and 16 knots speed, carrying four 13 inch, four 8 inch, and fourteen 5 inch guns, the last being rapid-firers, with 26 smaller guns.

The three ships of the Alabama class, of 11,520 tons and 16 knots speed, carrying four 13 inch guns and fourteen 6 inch rapid-firers, with 28 smaller guns.

These ships, which should all be in commission within the next three or four years, will constitute a formidable addition to our first line of defense. Taken with the three first-class battleships of the Indiana class, which are of less displacement but greater offensive power, they will give the United States a fleet of nine first-class battleships, admirably adapted by their similarity in speed for maneuvering in fleet formations.

At the same time it should be remembered that all naval preparation should be anticipatory, especially in the construction of battleships. With the plant that already exists in the country it would take at the very least three years to build and equip one of these floating fortresses, and not all the patriotism and wealth of the country could lessen the time of construction by an appreciable amount. The day when it was possible to "create" a navy passed away with the passing of the shipwright with his ax and his adz. Modern battleships are no longer created; they are the result of a steady growth, whose period is measured by years instead of months.

For this reason it would, perhaps, be a wise policy to institute a regular programme of shipbuilding, with provision for the regular addition of so much tonnage each year. By such an arrangement the cost would be evenly distributed, the burden of it lightened, and the nation would be saved from the dangers of panic expenditure on the one hand and of absolute neglect of the navy on the other.

Regarding the important question of the price of armor plate for the new ships the report says:

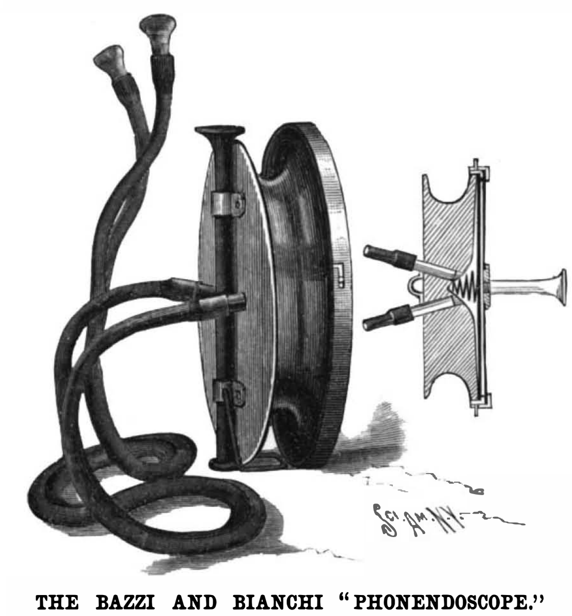
"In dealing with this question of cost, however, the committee has regarded it as one of such technical character that the information at its command is not sufficiently definite to enable it to fix with certainty a price per ton upon such a product of manufacture, and it has been indisposed to do so."

A lump sum is provided for the purchase of armor for the three ships now building, and the maximum price of $400 per ton named by the Secretary of the Navy is practically adopted. This figure must not be exceeded; at the same time he is free to secure the armor at a lower price if he can do so.

Nobody will dispute the fact that "the question of cost" is one of a "technical character" any more than they will the fact that if American manufacturers have been selling Harveyized armor to the Russian government for half the price they were charging the home government, the question of cost has a decidedly commercial character as well. Granting that in the present emergency the suggestion of Secretary Herbert represents the best compromise that can be made, it is to be hoped that in the thorough discussion which the bill will receive in the House and Senate, the actual facts regarding the Russian order and the cost of manufacturing armor plate in this country will be established.

A "PHONENDOSCOPE" OR IMPROVED PHONOSTETHESCOPE.

A simple device for rendering distinctly audible on a magnified scale small sounds in the human body, or in



THE BAZZI AND BIANCHI "PHONENDOSCOPE."

bodies in general, is represented in section and in perspective in the accompanying illustration. It was patented by Eugenio Bazzi and Aurelio Bianchi, of Florence, Italy, in several European countries, in 1895, and a patent therefor has recently been issued in the United States. The improvement is based essentially on the fact that a vibratory elastic membrane, united with a body of larger mass and greater inertia, when laid upon another body in which small sounds occur, cause a vibratory action to be set up in the membrane, while the large mass of the heavy solid body is but very slightly or imperceptibly affected. As shown in the sectional view, the inert disk of heavy metal or weighted wood has a central hollow cavity covered by a membrane of hard rubber or similar material constituting a diaphragm, and inside the space thus formed is a weak spring pressing upon the diaphragm. The membrane is packed tightly against the edge of the disk by a clamping ring, and over the membrane is a somewhat thicker hard rubber plate, which preferably has a central orifice where may be secured a hard rubber or metal rod, which, when not in use, may be detachably fastened on the rear side of the instrument. In the rear of the disk are two holes which terminate in the central hollow, and here are inserted hearing trumpets or flexible tubes leading to the ears of one using the instrument, when the latter has been placed in position where the sounds to be noted or detected are looked for. Either the knob on the end of the rod, or the hard rubber outer plate of the instrument, is placed in contact with the body where the sounds are expected, and the tone vibrations cause movements of the plate far greater than those of the box, the heavy disk being comparatively inert, and these vibrations are communicated to the sense of hearing through the connected tubes.

GRANT'S MACHINE FOR SOLVING NUMERICAL ALGEBRAIC EQUATIONS.

BY GEORGE B. GRANT, PASADENA, CAL.

There is no branch of algebra upon which more labor has been spent than upon the "theory of equations," which treats mainly of the determination of the roots of equations of the form

$$ax^5+bx^4+cx^3+dx^2+ex+f=0$$

and Sturm's theorem is the only complete solution of the difficult problem of finding the roots of such equations when their coefficients are numerical. To quote Prof. David E. Smith, a recent writer on the history of mathematics, "All processes were, however, exceedingly cumbersome until Sturm (1829) communicated to the French Academy the famous theorem which bears his name and which constitutes one of the most brilliant discoveries of algebraic analysis.

But there is more than one way to look at almost any subject, and this paper is to describe a machine to determine these roots approximately with but the least amount of assistant calculation.

The object is to discover the numerical values, called "roots," which, substituted for the unknown quantity, x, in any numerical example, such as $7x^3+3x^2-15x-4=0$ for example, will satisfy that equation and reduce it to zero. Theoretically, Sturm's theorem will completely determine all the real roots, but that method is so difficult to apply to decimal fractions that it is always abandoned after the integers have been discovered, and the solution completed by some other process. The machine is subject to a similar limitation, for, unless the mechanism is of the most delicate and costly description, it will give roots that are reliable only to one or two decimal places. It is, therefore, like Sturm's theorem, a means for so far locating the roots that they may be worked, if required to be very accurate, by some such rule as Horner's method.

There are two sets of scale beams, one more in number than the degree of the largest equation the machine is required to solve. Half of these beams are pivoted to balance on a fixed post and the other half are mounted on a movable post. On each beam is a coefficient weight which may be set in either positive or negative position on it by means of a scale of coefficients. The position of the movable post is shown by a scale of roots. This is essentially the whole machine, although there may be many refinements for unusually accurate work.

An examination of the engraving will show that it is a multiplying weighing machine, each beam being coupled to the next, so that the effect is continually multiplied. When all the pins are in the same vertical line the multiplier is unity, and when each pin is at the fulcrum of the beam it is working in the multiplier is infinity. Between these two points, unity and infinity, the multiplier is the proportion of the fixed distance of the pin from the fulcrum of its own beam to its variable distance from the fulcrum of the beam it is working in. This proportion, which is denoted by x, is uniform for all the beams for the same position of the movable post.

If the weight on the lower beam be set at any figure on its scale denoted by "$\pm a$," the effect on the second beam will be "$\pm ax$," for the effect of the weight on its own beam at the unity point is indicated by the scale, and that effect is multiplied by x at the unity point of the next beam. As the second beam has a weight set at "$\pm b$" that will be added at its unity point so that the total effect on that beam will be "$\pm ax \pm b$." This, in turn, is transmitted to the third beam and multiplied by x as well as added to the weight "$\pm c$" on that beam, making the total effect "$ax^2 \pm bx \pm c$." Similarly, the effect on the fourth beam is "$\pm ax^3 \pm bx^2 \pm cx \pm d$," and so on as far as the system extends. That being the compound effect of the weights acting on each other in succession, it is seen that the six beams will balance only when the resultant or total effect is zero, that is, when

$$\pm ax^5 \pm bx^4 \pm cx^3 \pm dx^2 \pm ex \pm f = 0$$

and that is the algebraic equation of the fifth degree in its most general form. Therefore, if the coefficient weights be set in their several positions and the post moved until the beams balance, the scale of roots will then show the proportion x and solve the equation.

The machine as here shown will directly find only the roots situated between unity and infinity, both positive. If the slot is continued past the fulcrum, toward the negative end of its beam, the machine will find negative roots also, but it is much more practicable to simply shift the weights on the fixed post each to the same reading at the other end of its beam, thereby changing the signs of all the roots of the equation and enabling the negative ones to be determined as if they were positive. If the slot is continued beyond the unity point the machine will find roots smaller than unity, but would never quite reach the root zero, so it is necessary to make a separate search for any roots there may be between plus unity and minus unity, after so transforming the equation as to shift all of its roots in the positive direction two integers.

It is plain that if a weight is set at 0, or taken off its beam, that coefficient is 0, so that the machine will

solve partial equations, such as $x^5 + bx^4 - dx - f = 0$. It is, therefore, a machine for extracting any root of a number, for that requires only the solution of the binomial equation $x^n - f = 0$. If, for example, the weight, "a," is set at + 1 and the weight, "f," at —17, the machine will balance only at 1·76, the fifth root of 17, for the equation solved is then $x^5 - 17 = 0$, or $x = \sqrt[5]{17}$

To detail an example, suppose the equation

$$2x^5 + x^4 - 11x^3 + 7x^2 - 13x + 6 = 0$$

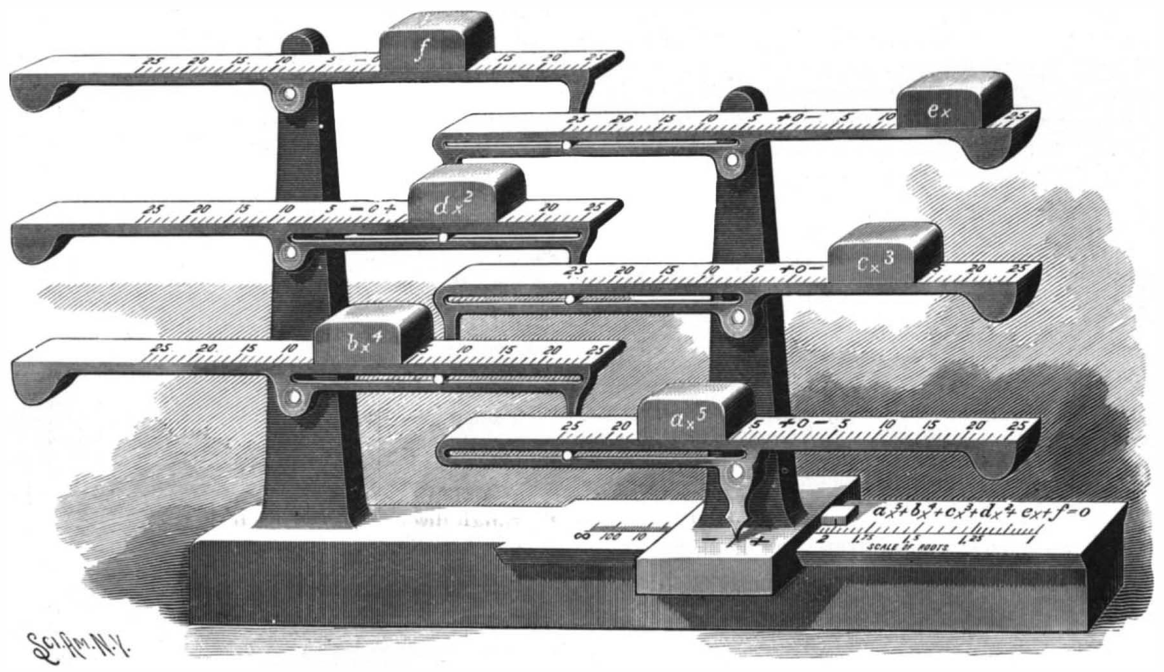
is to be solved.

The weight, "a," is set to + 2, and the others to + 1, —11, + 7, —13, and + 6, respectively, and the post moved to a position at which the beams will balance. It can be made to balance only at 2, showing that + 2 is the only positive real root between unity and infinity. Now shift the weights, b, d, and f, each to the same setting on the other end of its beam, and again move the post over the scale of roots. It will find a balance only at 3, showing that —3 is the only negative root between unity and infinity. But there are five roots of the equation and there may be more between the unit points. Transforming the equation so as to add 2 to each of its roots, any root between + 1 and —1 will be moved up to some point between 1 and 3, and the equation will be $2x^5 - 19x^4 + 61x^3 - 63x^2 - 45x + 100 = 0$. Setting this equation upon the machine and moving the post only from 1 to 3, we find that it balances only at $2\frac{1}{2}$, showing that $+\frac{1}{2} = 2\frac{1}{2} - 2$ is the only real root besides 2 and —3. As there are five roots in all, there must be two imaginary roots, but the machine will not assist in finding them, for the reason that an imaginary root is an algebraic fiction and not a mechanical quantity.

The delicacy and accuracy of the machine is greater as the root is smaller; therefore, if a very large root be roughly determined, the equation can be transformed so as to reduce its size and enable it to be measured with greater precision.

There is no limit to the possible refinements in the way of agate bearings, micrometers, etc., but they are expensive and are not needed. A machine of very ordinary construction will determine a root to hundredths if it is near unity, and any root can be set in that position by an easy transformation of the equation. Even a wooden model will get the roots ready for extension by Horner's method.

If only two adjacent beams are weighted, the machine will perform ordinary multiplication and division of numbers, for the equation $ax - b = 0$ will give $ax = b$ and also $x = b \div a$, but the range in this case is too small for ordinary purposes.



GRANT'S EQUATION MACHINE.

THE Bréant prize of the Paris Academy of Sciences for 1897 is to be awarded for the discovery of a remedy which will cure attacks of Asiatic cholera in the great majority of cases. The prize is of the value of 100,000 francs. The memoirs must be sent to the Academy before June 1 next.

TORPEDO BOAT NUMBER 6, FOR THE UNITED STATES NAVY.

We give an illustration of the fastest vessel of any kind ever built in America, torpedo boat No. 6, which on its trial trip maintained an average speed of 28·74 knots per hour for a distance of 60 miles. This is equal to 33·1 statute miles per hour, a speed which not a great many years ago would have been equal to the average all day speed of our passenger trains.

The course was 12 miles long and it was covered in five successive runs. On the first run she crossed the line carrying a steam pressure at the engines of close upon 220 lb. to the square inch, and her engines were running at the high speed of 405 revolutions per minute. There were two excellent features that were immediately apparent to those on board, the first being the absence of any banking up of a heavy bow wave (the commotion which our readers will notice in the cut being merely the surface foam); the second good feature was the absence of that extreme vibration which is usually felt in a torpedo boat when she is pushed to her full speed. The quiet way in which she cuts through the water will be an invaluable feature during a night attack. It will increase the chances of stealing up to the enemy unobserved, and the silence and smoothness with which her engines run at high speed will also be greatly in her favor. It was remarked by the officials on board that the vibration was not sufficient to interfere with writing legibly in any part of the vessel. Any one who has been aboard one of the 30 knot torpedo boat destroyers on a trial trip will appreciate what this statement means. It is well known that torpedo boat service is about the most trying that exists in any navy, and much of its discomfort arises from the perpetual jarring to which the crew are exposed. The vibration is due to the fact that such enormous horse power is crowded into a little vessel of extremely light construction.

It is a difficult problem to place in a boat only 175 feet long and $17\frac{1}{2}$ feet wide a set of 4,000 twin engines that shall drive the propellers at over 400 revolutions per minute, and do it without shaking the little craft from stem to stern. The lightness of the construction of No. 6 may be judged from the fact that there is not a plate in her hull that is more than a quarter of an inch thick.

The first heat of twelve knots was run off in 24 m. 52 s., at a speed of 28·97 knots. The second was made in 24 m. 57 s., corresponding to 28·85 knots. The third trial resulted in a speed of 28·78 knots, and the fourth showed a speed of 28·87 knots. The average for the 48 knots was, therefore, 28·87 knots. The last run had scarcely commenced when one of the blowers broke down, a mishap which caused a falling off of the steam pressure and brought down the speed to 28·23 knots, which was 0·73 knot above the contract requirement. The average speed of the whole 60 knots was $1\frac{1}{4}$ knots above the contract speed of $27\frac{1}{2}$ knots.

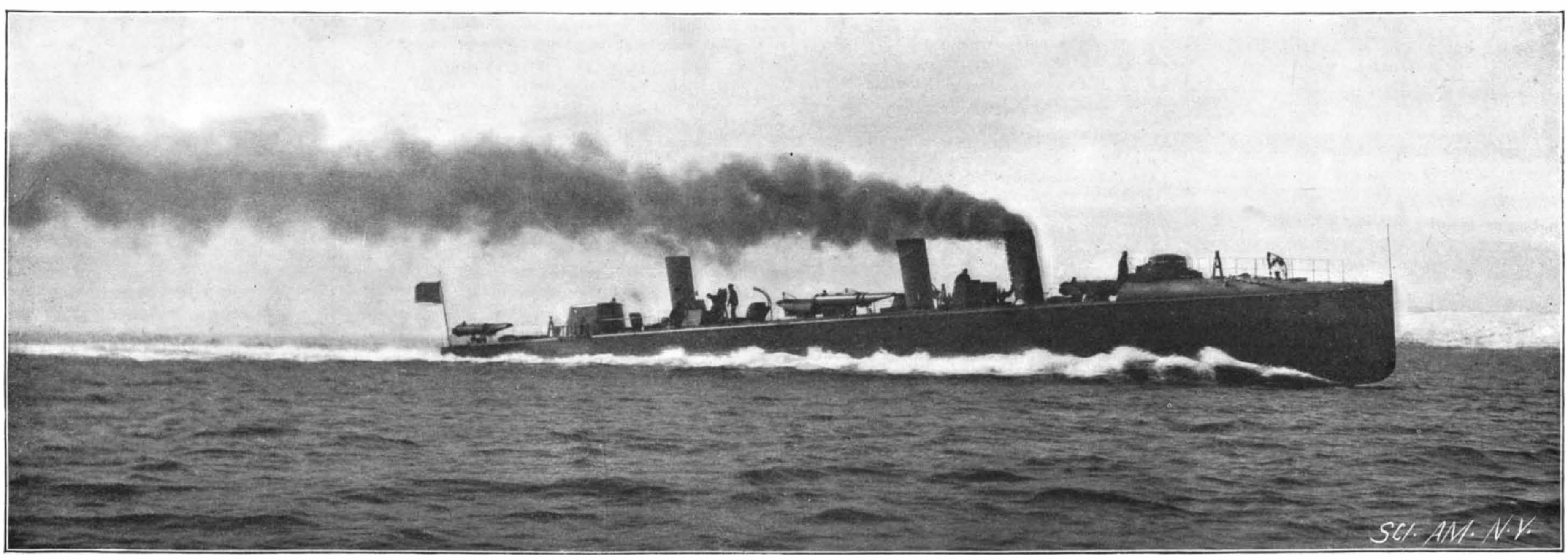
The maneuvering powers of the new boat are excellent, the turns at the end of each run being made in a very small circle, and although the helm was "hard over" the amount of "heel" was insignificant.

She carries three torpedo launching carriages, one forward on the port side, one amidships on the starboard side, and a third at the stern on the center line. She is also armed with three 1 pounder rapid fire guns. The full complement of the little ship is four officers and twenty-four men.

The remarkable success of this little craft will give increasing interest to the trials of the three 30 knot boats which are now building for the navy, one on the Pacific coast and two on the Atlantic. If they show as great an advance on contract requirements as No. 6 has done, it is possible that the record for torpedo boat speed may remain for a few months on this side of the water, or until the new 32 knot destroyers for the English navy shall have had their trials.

The Origin of the Druggists' Show Bottles.

An interesting story is told by the Chicago Grocer in connection with the familiar red, yellow and green vases that brighten the windows of drug stores. The custom of placing them there originated with an apothecary who found himself one night minus the red light with which tradesmen of his class were accustomed to ornament their store fronts. To make up the deficiency he got a bottle of red liquid and placed a candle behind it. The effect pleased him so well that he decided to improve it by placing a second red light in the window, with the aid of another bottle of red mixture and an additional candle. This sign made such a brave showing that an envious rival cast about for means of improving on the sign. He hit upon the scheme of placing a bottle colored with yellow fluid beside the red one, and then surpassed his previous effort and carried all before him by placing a green bottle beside the yellow. The three made a sign that caught the town, and all the druggists quickly fell into line. The bottles were replaced with the handsome vases at present in use, and the druggist's sign was here to stay to brighten the dingy streets of town and village.



TORPEDO BOAT No. 6, FOR THE UNITED STATES NAVY ON HER TRIAL TRIP.

Speed, 28·74 knots per hour. From an instantaneous photograph. Copyrighted, 1897, by F. H. Child.

RECENTLY PATENTED INVENTIONS.

Engineering.

TUBULAR BOILER.—Sweney Munson, Sayre, Pa. This boiler has an outer and an inner shell, with manifold at each end of the latter and water flue connections between them, there being forward of the inner shell a crown sheet having a water leg, while circulating tubes having connection with arched braces extend through the crown sheet. It is designed that the boiler will require a less number of stay bolts than are at present necessary, to reduce the liability to leaky flues to a minimum, and afford greatly increased heating surface, the construction also being such that every flue can be easily inspected and cleaned.

STACK DRAUGHT PRODUCING DEVICE.—John C. Raymond, New York City. To secure induced draught and reduce the height and cost of chimneys and funnels by the use of fans, this invention provides for a mechanism in the funnel top comprising an arm mounted to swing and carrying at its free end a fan, there being a rack quadrant on the arm with which meshes a worm carried by the shaft of an electric motor. As applied to the chimneys of stationary boilers on land, the invention is design d to enable their height to be greatly reduced, effecting great economy in the cost of boiler installation, while in a steamship funnel a great increase of draught is attained without the disadvantage attending the employment of forced draught.

COAL HANDLING APPARATUS.—Ephraim Smith, West New Brighton, N. Y. To facilitate the transfer of coal from barges, boats and cars to bins, or from the latter to steam vessels, or for use in dredging and other purposes, this invention provides an elevator which slides and turns, and with the lower end of which is pivotally connected a conveyer adapted to discharge into the boxes of the elevator, the elevator boxes discharging into a chute fastened to the elevator frame, while a second chute slides in the first chute and a fixed inclined chute made circular is engaged by the lower end of the slidable chute, so that when the elevator is moved up or down or turned a connection between the three chutes is maintained. The whole elevator and its conveyer part can be swung to either side out of the way of an approaching vessel.

WATER ELEVATOR.—Joseph McMurrin, Shoshone, Idaho. This invention is for an improvement on a former patented invention of the same inventor, and consists principally of an endless paddle wheel belt having its lower run extending into the water, while an endless bucket elevator has its lower run carried by the lower run of the paddle wheel belt, the endless paddle device propelling the elevator so that the buckets can be filled with water, be lifted a suitable height, and discharge the water into chutes. The elevator has a float with decks and forming a breakwater at one side, and is set at a quartering position in the running stream as a protection against drift, while also allowing the current to strike the paddles separately.

Railway Appliances.

CAR COUPLING.—James E. Betts, Wilmington, Ohio. According to this invention the drawhead is chambered to receive a coupling link and transversely slotted to receive a pin, there being a pin lifter device comprising a rock arm having a member pivoted to the side of the drawhead, a transverse lever pivoted on the upper end of the rock arm, while a lifter arm having loose connection with the lever is looped to receive and lift the pin. A guide limb depending from the looped portion of the lifter arm is slidable in a vertical perforation of the drawhead. The improved coupling will automatically couple meeting cars, and the uncoupling may be readily effected without trainmen going between the cars.

Mining, Etc.

SLUICE BOX.—Christoffer A. Christensen, Oretown, Oregon. To save the fine gold mixed with dirt and sand this inventor has devised a box in which two currents of water are employed, one to carry the sand and gold along the surface of a gathering bed of burlap or similar material, while the other is directed upward through the burlap surface, to keep the commingled sand and gold stirred from beneath by a sort of boiling movement, to promote the separation of the gold and facilitate the passage of the gold and sand along the burlap bed. The upward force of the water is designed to be strong enough to prevent any great amount of sand from falling down, but not strong enough to keep the gold from sinking through the burlap. The device is especially adapted for working black sand and other deposits carrying finely divided gold.

Mechanical.

REVERSING GEAR.—Charles Wagner. New York City. For use on screw cutting and other machines this invention provides a device which may be set to reverse automatically when the desired length of thread has been cut. A clutch sleeve is held to slide and be controlled by the work or the carriage supporting the work, two clutches carried by the spindle being supported by the sleeve, and the clutches being adapted to engage driving pulleys rotating in opposite directions. The shifting of the clutch sleeve causes a turning of the spindle first in one and then in the opposite direction, the device being very strong, simple, positive in movement, and not liable to get out of order.

GRINDING MILL.—Jacob Pfeiffer, Kaiserslautern, Germany. This is a ball grinding mill with wind separator, in which the use of sieves is avoided, a casing through which extends centrally a feed hopper inclosing the grinding mechanism, while a vane rigid with the casing is interposed between an exhaust fan and the grinding mechanism, a ring held to the casing embracing the feed hopper. In the operation of the mill the reduced pulverized material rises upward in the casing and is drawn out by the fan and thrown into an annular space where it passes out through a discharge pipe, only reduced material being drawn out.

Agricultural.

FRUIT GRADER.—Willis Brown, Portland, Ore. For the purpose more especially of grading dried prunes, this inventor provides an upright frame in which are supported three or more grading frames, held together by straps and suspended by links, the grading frames being alike except that each screen has a smaller mesh than the preceding one. Each grading frame has a bottom which delivers to the upper end of the next lower frame, and provision is made for jolting the screens by an operating shaft moved by hand or other power. The prunes passing from the discharge chute of the upper screen are the largest or first grade, and those from the successive screens below are of correspondingly diminished size.

APPARATUS FOR UNCHAINING CATTLE.—Joachim Vietheer, Kollmar, Germany. For simultaneously uncoupling and letting loose cattle when a fire breaks out in a stable in which they are confined, according to this invention, there are along the wall of the crib or manger clamping jaws, above each of which is a catch pivoted on a bolt, a shaft supported by brackets extending along the wall of the stable in front of the catches. The clamping jaws securely hold the chains attached to the animals, but by turning the shaft by means of a hand wheel, the catches are lifted, loosening the clamping jaws and withdrawing the bolts, thus releasing the animals.

Miscellaneous.

ICE VELOCIPEDE.—Mathias Kolbenson, Marysville, Montana. The frame of this machine has an adjustably held front runner or skate and a rear driving wheel adapted to be operated from the pedal crank. A rear runner or skate has a central slot through which slightly projects the thin toothed periphery of the rear driving wheel, springs bearing upon this runner to press it normally downward, and there being means for regulating the tension of the springs to adjust the position of the skate relative to the driving wheel. The driving wheel may thus be caused to take more or less deep hold upon the ice or snow, and the springs also relieve the rider from jolting.

CALCINING APPARATUS.—Thomas McNeal, Gypsum City, Kansas. To cook or calcine plaster or similar material, the apparatus covered by this patent is of such construction that the whole body of plaster is subjected to a practically even degree of heat by an economical use of fuel. The calcining vessel is so supported within the casing or wall of the furnace that the products of combustion are directed over its entire bottom and side surfaces, while flues at different levels carry the products of combustion transversely through the vessel. Means are also provided for stirring or agitating the material while it is being calcined.

DISPLAY STAND.—Daniel Henderson, Kingsley, Iowa. For conveniently keeping sickle sections, ledger plates and similar articles usually kept in hardware stores and implement houses, in such arrangement that a salesman may readily pick out the article desired, this inventor has devised a stand in which horizontal spring arms connect posts, the arms being attached to a support on which the posts have movement to and from each other. The stand is adapted to receive the various articles as on a file, showing their different sizes, the year or years in which the machines were made to which the plates are adapted, the size of the rivets necessary, as well as the cost and sale price of the wares.

SAVINGS BANK.—Clarence L. Dawson, Tacoma, Washington. This is a pocket bank, or a device in the form of a watch, and is especially adapted for the reception of coins of a specified value. It has one or more depositories for coin, and cannot be opened without a proper key. It also has a registering device to indicate the amount of money that has been deposited in it.

COMBINATION LOCK.—Foster J. Heacock, Salem, Ind. A disk in the casing of this lock has sets of apertures and plugs for closing all except one aperture of each set, while a dial on the knob spindle is provided with shafts carrying pins on their inner ends. A second casing is secured to the inner end of the first casing with a knob spindle having a socket to receive the end of the outer sliding knob spindle. The combination admits of many changes, and may be readily changed as desired, while it cannot easily be tampered with.

TRANSOM LIFTER AND LOCK.—George M. Parsons, Carson, Nevada. This invention is for a simple, durable and inexpensive device by means of which the position of the transom may be quickly and conveniently adjusted by means of a cord which extends down to the hand. A spring-controlled sleeve slides on a support having a rack surface, the sleeve carrying a pivoted latch adapted to slide over and engage the rack, while an arm carried by the sleeve is arranged for connection with the transom.

QUILTING FRAME.—Mary Jenson (Mrs. Mary Butterfield), Ogden, Utah. For quilting or embroidery, or for stretching or drying lace curtains, this inventor has devised a simple style of frame which can be quickly and easily adjusted to suit various sized articles, and one which permits the rolling of the fabric on the frame as the work progresses. It has side and end bars which are made in sections and have a vertical portion provided with longitudinal grooves, a series of pins being set in the horizontal portion, and there being a detachable hinge connection between the sections. Slotted sliding sleeves are adapted to fit on the grooved portion of the bars.

HARNESS NECK YOKE IRON.—Welcome Craford and Joseph S. Atkinson, Bayfield, Wis. This device has a tubular body from whose lower rear portion projects a lip having on its under face a flange at each side of the center, there being a spring in the space between the flanges and its bearing being at the outer end portion of the body. A stirrup through which the spring passes is located between the ends of the lip flanges and the bearing. The device is very simple and inexpensive, and with the aid of but two snaps a teamster may, with this improvement, couple or uncouple the horses in the coldest weather without removing his mittens or other coverings from the hand.

REVERSIBLE SAD IRON.—Elliott Preston, Sturgeon, Mo. This is a hollow iron to be heated by an ordinary spirit lamp, the handle of the iron having a spring seat for the lamp and two trunnions on which the iron turns. The rear trunnion carries clamping arms and a spirit lamp to engage the seat, its wick tube passing between the clamping arms to hold the lamp in place. The sides of the iron preferably have damper openings, buttons controlling the dampers conveniently.

HINGE FOR COOKING UTENSILS.—Eber W. Pratt, Ipava, Ill. This is a device especially adapted for attachment to the covers of pots, skillets, stew pans, etc., and may be readily secured to the pot or the body of the utensil to which the cover is to be fitted. It is made of bent wire, and is so formed as to constitute a hinge by which the cover may be tightly closed over the body of the utensil, or may be raised and held upright, preventing the cook or user from burning the fingers in removing the lid or cover.

COFFEE ROASTER.—John McLean, Miller's Ferry, Ala. This roaster comprises a casing in which is a spring-operated rotary drum, there being below the drum a burner and an extinguisher therefor, consisting of pivoted and spring-pressed plates, the latter connected to a lever adapted to be engaged by the operating spring as it uncoils. The device is simple and inexpensive, works in a measure automatically, and is arranged to prevent the coffee from being burned or smoked.

PENHOLDER.—William H. Walker, Dover, Del. An improved penholding attachment for a pen stock, adapted to readily clamp or release a pen, is provided by this invention. It comprises a barrel with interior sleeve having an interior projection, there being in the barrel a pivoted clamping plate. Two jaws are adapted to hold the shank of the pen, one of the jaws being pivoted and engaged by a laterally oscillating member whose movement is limited by a stop.

TWINE HOLDER.—Frank Bossong, Ellensburg, Washington. This device is of the class in which the twine receptacle is combined with a take-up rod to lift the end of the cord normally out of the way. The carriage with twine box is movable on a vertical track or guide, the twine passing over a roller above the box, and pivotally connected with the carriage is a take-up rod which is held upwardly inclined by a spring.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

SKETCHES IN CRUDE OIL. Some accidents and incidents of the petroleum development in all parts of the globe, with portraits and illustrations. By John J. McLaurin. Harrisburg, Pa.: Published by the author. 1896. Pp. x, 406.

This very long work, for its fine and clear type make it longer than its pages would indicate, with numerous illustrations, is most instructive reading for those interested in the development of the oil industry in America. It is a book which details anecdotes and stories of life in the oil regions, which tells of the sudden rise to fortune of humble men, which gives the lives of members of the Standard Oil Company and of other magnates. Short stories and a generally narrative treatment add considerable interest to the work, besides which it gives very graphic illustrations of scenes connected with the oil industry. The point which we wish to emphasize is that it is a thoroughly popular book of the history of an important industry of America and of the fortunes which have been made by it, and is suited for the popular taste.

GAS, GASOLINE, AND OIL VAPOR ENGINES. By Gardner D. Hiscox, M.E. New York: Norman W. Henley & Company. Illustrated with 206 illustrations. Pp. 279. Large octavo. Price $2.50.

The explosion motor in the form of gas or oil engine is constantly increasing in importance in the technical world. The ease of starting such motors, the absence of a boiler, the use of what may be termed concentrated heat in producing their motion, with the ensuing diminishing of the loss in economy under the second law of thermodynamics, have given them a value which is only beginning to have its proper effect. The public have at last awakened to their importance, and to the lateness of such awakening we may attribute the fact that so little literature on the subject exists. Mr. Hiscox's book, devoted to American practice, is practically unique in subject, and this fact, superadded to its merits and the authority of the widely known engineer who writes it, gives it a value all its own. The range of the work extends from theory to practice and includes the consideration of the features of economy and causes of waste. The book treats of the design of engines and proportion of parts, of their management, rating and determination of their efficiency. A valuable list of patents for ten years is included. The illustrations number over two hundred, nearly one for each page of the book, and their quality leaves nothing to be desired. An index is appended. The list of patents is interesting, showing for 1875 but three patents, including one under the classic name of Daimler, while for 1896 over eighty patents are registered.

AN ECLIPSE PARTY IN AFRICA. By Eben J. Loomis, of the United States Scientific Expedition to West Africa, 1889-90. Boston: Roberts Brothers. Pp. 218. Price $4.50.

The contents of this sumptuously gotten up, handsomely illustrated book are wholly dissociated from the scientific work of the expedition in which its author bore a part, and cover only matters of popular interest, such as usually found in books of travel. Two interesting chapters, with some fine pictures, are given to the island of St. Helena, and one to the diamond mines of Kimberley.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7118) C. J. C. writes: 1. Why is it that an alternating current of electricity will blow fuses in line if its two sides are crossed by anything except an incandescent lamp? In other words, if you connect sides by anything except an incandescent lamp, it will blow fuses, but you can cross it by lamp and it will not blow. A. Simply because the "anything" is of lower resistance than a lamp. If the connection is of adequate resistance, the fuses will not blow out. 2. Also can two or more T. H. or other direct current arc machines be connected together? If so, how? If not, why not? A. Yes; either in series or parallel, by connecting the leads from the binding posts. 3. Are there any books on alternating current for amateurs which you can recommend? A. We can supply the following books on alternating currents: "Alternating Electric Currents," by Houston & Kennelly, $1; "Alternating Currents of Electricity," by Kapp, $1; "Alternating Currents," by Bedell & Crehore, $2.50; Tesla's "Experiments with Alternate Currents," $1 by mail postpaid.

(7119) O. F. H. asks: An old sailor has told me that the needle of the mariner's compass points toward the south pole after the ship crosses the equator; please let me know through your query department whether this is a fact. A. No reversal takes place. The north pole points north and the south pole south approximately, the direction varying with the locality. It is a mere question of expression to say which end of the needle does the pointing.

(7120) A. L. M. writes: 1. How can I form storage battery plates quickly by Plante's process? What is the best oxidizing solution to form the plates electro-chemically in a short time, say 10 hours? A. There is no quick way of forming plates. Dilute nitric acid, 1 acid to 10 water, may be used for a preliminary immersion to corrode the surface. 2. How many amperes should be used per square foot of positive plate in forming? A. Allow 4 to 6 amperes. 3. How strong should the sulphuric acid solution be, and how much should the acid rise when a storage cell is charged? A. Before charging, sp. gr. 1·170; after charging, 1·195. 4. How can I use Baumé's hydrometer for testing the specific gravity of an acid solution? A. By floating it in the acid and comparing its readings with the table calculated for the purpose. It is much better to use a hydrometer graduated on some other basis, as much confusion exists in the matter of Baumé equivalents.

(7121) A. asks: 1. Will common tomato cans answer the purpose for jars in the caustic potash battery described in "Experimental Science"? A. They will do for a cheap battery. 2. What is a cheap way to make black copper oxide? A. Heat scrap copper to redness on a pan or slab of fire clay. After it cools pound off the oxide, reheat and repeat pounding. The process is not really cheap. The expense of the oxide is the great objection to this battery. 3. Please tell me where the energy goes in the following case: A common clock spring is wound up; it is then put in the fire and the temper taken out. The spring will now not unwind. Where does the energy go? A. The energy is represented by the heat due to the winding. This heat disappears from our recognition, as the air takes it up. The wound clock spring contains no energy due to its tension. It can on unwinding utilize the heat energy of the air and of itself and grow cool in so doing. 4. Is magnetism energy? If so, where does it go when you put a permanent magnet in the fire? A. No. It is force, and is destroyed by heating the magnet.

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Coin holder case, F. B. Wagner 26,637
Electric switch base, G. W. Hart 26,650, 26,651
Ewer, W. H. Grindley 26,630
Fabric, J. N. Wiggin 26,665, 26,666
Fan, J. M. Rector 26,626
Flower holder, S. M. Griswold 26,631
Fruit holder, E. Strebeck 26,633
Globe or shade, E. F. Caldwell .... 26,640 to 26,647
Grate, A. S. Newby 26,653
Hammer, tapping, J. B. Meier 26,638
Inhaler, etc., A. H. Ramey et al 26,636
Lamp frame, arc, J. A. Mosher 26,649
Lamp globe, L. M. Cargo 26,648
Portieres, etc., rope for, I. Dreyfus 26,664
Puzzle box, S. A. Cross 26,661
Puzzle box, C. J. Hartley 26,662
Rake, A. W. H. Woizeski 26,659
Shoe, A. A. Kohn 26,663
Shoestring fastener, Webb & Andress 26,635
Soap or similar articles, holder for, C. L. Wilkins 26,632
Spoons, etc., handle for, J. Clulee 26,627
Stove, cooking, F. E. Lee 26,656
Stove, heating, H. L. Mosher 26,654, 26,655
Stove or range, F. E. Lee 26,657, 26,658

TRADE MARKS.

Cards, playing, A. Dougherty 29,574

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents. In ordering please state the name and number of the patent desired, and remit to Munn & Co., 361 Broadway, New York. Special rates will be given where a large number of copies are desired at one time.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list, provided they are simple, at a cost of $40 each. If complicated the cost will be a little more. For full instructions address Munn & Co., 361 Broadway, New York. Other foreign patents may also be obtained.

Advertisements.

ORDINARY RATES.

Inside Page, each insertion - - 75 cents a line
Back Page, each insertion - - - - $1.00 a line

For some classes of Advertisements, Special and Higher rates are required.

The above are charges per agate line—about eight words per line. This notice shows the width of the line, and is set in agate type. Engravings may head advertisements at the same rate per agate line, by measurement, as the letter press. Advertisements must be received at Publication Office as early as Thursday morning to appear in the following week's issue.

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ORDINARY RATES.

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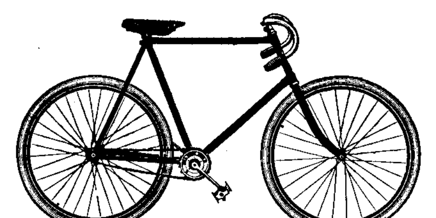
Tribune Bicycle

Tested and True.



The Easiest Running Wheel in the World.

☞ *Send for Catalogue.*

THE BLACK MFG. CO., ERIE, PA.

Nickel Silver Watches

We are casing all sizes of movements in this new metal. It takes a better finish and is more enduring than sterling.

It supersedes the old nickel plate, and enables one to have a perfect timepiece at small cost.

Our Solid Gold and Filled Cases, as well as Sterling Silver and Enameled patterns, are in greater variety this season than ever.

New specialties have been added.

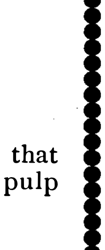
Our '97 Model

Trump Cyclometer,

the 10,000 mile wheel recorder, are all shown in our new catalogues, which will be sent to all.

The Waterbury Watch Co.
WATERBURY, CONN.

AMERICAN SCREW CO'S
New Cold-Forged Wood Screw



☞ *Send for Sample.*

Patented May 10, July 19, '87; Oct. 29, '89; Aug. 19, Oct. 21, '90; April 7, May 12, '91; July 19, '92.

FACTORIES: PROVIDENCE, R. I. LEEDS, ENGLAND. HAMILTON, ONT.

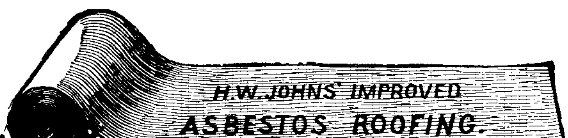
AGENCIES:
New York, 94 Chambers St. Chicago, 19 Lake St.
Baltimore, 14 W. German St. San Francisco, 23 Davis St.
Philadelphia, 518 Commerce St. Boston, 36 Pearl St.

PARALLEL CLAMPS ALL ANGLES SIDES — C. H. BESLY & Co. Chicago Ill. U.S.A.

The American Bell Telephone Company,

125 Milk Street,
Boston, Mass.

This Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined Telegraph and Telephone, covering all forms of Microphone Transmitters or contact Telephones.



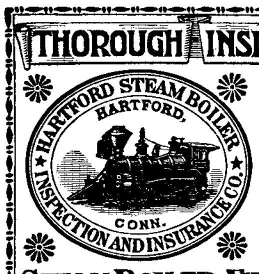
Improvements patented 1890 in the U. S., Canada and Europe.

FIRE PROOF—Proof against sparks, cinders, burning brands, etc.
STRONG—A heavy canvas foundation.
LIGHT—Weighs but 85 lbs. per 100 sq. ft. when laid complete.
FLEXIBLE—Contains no coal tar, and retains indefinitely its leather-like pliability and toughness.
EASILY APPLIED—Requires no kettle or other expensive apparatus. Can be laid by any intelligent workman.

ASBESTOS MATERIALS, LIQUID PAINTS, STEAM-PIPE AND BOILER COVERINGS, STEAM PACKINGS, ETC.
ILLUSTRATED DESCRIPTIVE LISTS AND SAMPLES FREE BY MAIL.

H. W. JOHNS MFG. CO., 87 Maiden Lane, New YORK.
CHICAGO PHILADELPHIA BOSTON LONDON

THOROUGH INSPECTIONS



AND INSURANCE AGAINST LOSS OR DAMAGE TO PROPERTY AND LOSS OF LIFE AND INJURY TO PERSONS CAUSED BY

STEAM BOILER EXPLOSIONS

J. M. ALLEN, PRESIDENT. W. B. FRANKLIN, VICE PRESIDENT.
J. B. PIERCE, SECRETARY. F. B. ALLEN, 2ND VICE PRESIDENT.

MANUFACTURE OF BICYCLES.—A very comprehensive article giving the details of construction of every part of these vehicles. With 15 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 908. Price 10 cents. To be had at this office and from all newsdealers.

The Kennelly Protractor

and Over 4,000 Other Tools are illustrated, described, and priced in

Our New 1897 Catalogue.

It is a book of 710 pages, 10½ x 7½ in. Mailed free to anyone mentioning this paper, and sending us 35c. Discount sheet with each book.

MONTGOMERY & CO., Makers of High Grade Tools, 105 Fulton St., New York City.

JESSOP'S STEEL THE VERY BEST FOR TOOLS, SAWS ETC. WM JESSOP & SONS LD 91 JOHN ST. NEW YORK

At ¼ Price Bicycles, Watches, Guns, Buggies, Harness, Sewing Machines, Organs, Pianos, Safes, Tools, Scales of all varieties and 1000 other articles. Lists free. CHICAGO SCALE CO., Chicago, Ill.

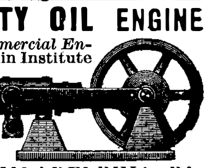
Buy a Watch

buy as good a case as you can afford, but first get a movement which will be accurate. Waltham Watches are the best time-keepers made in the world. The "*RIVERSIDE*" and "*ROYAL*" trade marks are specially recommended.

For sale by all retail jewelers.

PRIESTMAN SAFETY OIL ENGINE

"*A thoroughly successful commercial Engine using a Safe Oil.*"—Franklin Institute



No Extra Insurance, No Steam, No Gas. No Gasoline. Reliable, Safe, Economical, and Convenient. Chosen by Nine Governments. Used for nearly every purpose.

PRIESTMAN & CO., Incorp'd,
530 Bourse Bldg., PHILADELPHIA, PA.

DIXON'S 691 CYCLE CHAIN GRAPHITE saves wear of chain, prevents rust and increases ease, speed and comfort.

☞ It will pay you to send 10 cents for sample.

JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.

A Great Mining Triumph

Capt. J. R. DeLamar, of New York City, is one of the largest owners and workers of Gold Mines in the world. After the most careful investigation he purchased in August, 1895, two Griffin Mills, and his report is so remarkable as to demand the careful attention of every one interested in Gold Mining. We give it in his own words.

NEW YORK, Jan. 9, 1896.

BRADLEY PULVERIZER CO. *Gentlemen:*—The two Griffin Mills have been in operation now for 90 days on the hardest rock, with the exception of corundum, that I have ever met during my mining life. They have taken the rock direct from the breaker, and they average about 20 tons to each machine, 40 mesh fine, without elevating or bolting. We simply put a ¼ mesh screen around the Griffin Mill, and the stuff comes out 40 mesh fine or over, which makes it an excellent pulp for leaching by cyanide or chlorination; therefore we have concluded to order **10 more Griffin Mills**. We have tried high-speed rolls and dry stamps, and after looking into the Huntington Dry Pulverizer, the Narod Pulverizer, the Stedman Pulverizer, the Frisbie Lucop, the Cook, and various other dry pulverizers, unhesitatingly recommend your Griffin Mill to any one. Yours truly, (Signed) J. R. DELAMAR.

HOW 10 GRIFFIN MILLS WORK.

DELAMAR'S NEVADA GOLD MINING CO.,
SALT LAKE CITY, UTAH, Nov. 24, 1896.

BRADLEY PULVERIZER CO. *Gentlemen:*—In answer to your inquiry as to what the "Griffin Mill" is doing at our DeLamar Mill, DeLamar, Nevada, we beg to state that we often run 310 tons per day with 10 of your mills in operation, and on one occasion these 10 mills produced 408 tons in one day. I have no hesitancy in stating that they will regularly produce at least 30 tons per day each on our ore, which is extremely and unusually hard.

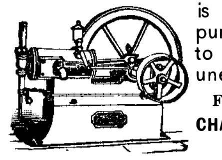
Yours very truly, H. A. COHEN, *General Manager.*

These strong letters coming from such representative men are conclusive evidence that we are right in claiming that the "Griffin Mill" will produce a larger amount of finer pulp at less cost than any other stamp or pulverizer made.

Let us send you a free copy of our illustrated pamphlet, which will tell you all about the Mill and bring to you other evidence of its great achievements.

BRADLEY PULVERIZER CO., 92 STATE ST., BOSTON, MASS.

THE ... CHARTER GASOLINE ENGINE



is used for almost every purpose power is applied to under the sun, and is unequaled.

Full particulars by addressing
CHARTER GAS ENGINE CO.
Box 148, Sterling, Ill.

IMPERIAL BALL BEARING AXLE

A written guarantee with each set of axles.

97 PATTERN

8,000 sets in use. Indorsed by the leading carriage builders. Reduces friction 75 per cent. One horse can do the work of two. Mechanically perfect. Can be put on old or new work.

☞ *Write for our Illustrated Catalogue and Testimonials, which we send free on application.* Imperial Ball Bearing Axle Dept., 184-190 Lake Street, Chicago, Ill.

To Bicycle Riders

WE MAKE OUR TUBE of FIFTY CARBON STEEL

Because a Tube like this of our | Is just as strong as a Tube like this of

.50% CARBON STEEL | **.25% CARBON STEEL**

While WEIGHT FOR WEIGHT in a Bicycle our **FIFTY CARBON Steel** will last so long

and **TWENTY-FIVE CARBON Steel** will last only so long . . . . .

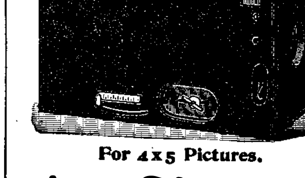
NOTE THE FULL IMPORT OF THE PARALLEL LINES.

The comparison which they graphically make indicates the result of the prolonged investigations of the most practical experts of the world.

That the tests in our own laboratory corroborate these results is merely so much to its credit: that the same is true of actual trial on the road equally proves the trial to have been made in bicycles of correct design and construction. THE FACT REMAINS.

The margin of safety is greatly increased by the use of this tube. Every bicycle manufacturer should use it; every dealer should insist on having it; every rider should demand it.

Send for Catalogue. **THE POPE TUBE CO., HARTFORD, CONN.**



No. 4 BULLS-EYE .. $12.00.

For 4x5 Pictures.

As Simple as a Pocket Kodak.

Loads in daylight with our light-proof Film Cartridges. Fitted with achromatic lens, improved shutter and set of three stops. Handsome finish.

EASTMAN KODAK COMPANY,

Booklet Free. Rochester, N. Y.

Have You Seen The Smoker's Tip?

It will prevent the poisonous irritation of tobacco upon the mouth and lip. This constant irritation has caused many a cancer. Prevention is better than cure. The SMOKER'S TIP will be mailed on receipt of 3 2c. stamps by the **ELASTIC TIP CO.**, Patentees and Mfrs. of **Rubber Specialties**, Boston, Chicago, San Francisco.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches & Elevators
PROVIDENCE R. I.

PRINTING INKS

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